

REMARKS

Claims 1-15 are pending in the application and are at issue.

The present claims are directed to compositions and to methods of controlling a fire wherein the fire-fighting composition comprises (a) a superabsorbent polymer, (b) a colorant, (c) an *additional* opacifying agent selected from calcium carbonate and a list of specific polymers, and (d) water. The composition also can contain an optional water soluble organic solvent or other optional ingredients (e.g., claim 6). The composition imparts a color to combustible objects such that treated objects can be differentiated from untreated objects. The color imparted substantially fades within 30 days after application. Claims 14 and 15 recite specific weight ratios of colorant to opacifying agent and of opacifying agent to superabsorbent polymer, respectively.

Claims 1, 3, 6, 7, 9, 11, and 13-15 stand rejected under 35 U.S.C. §102(b) as being anticipated by Katzer U.S. Patent No. 3,354,084 ('084). Claim 2 stands rejected under 35 U.S.C. §103 as being obvious over the '084 patent. The examiner contends that the '084 patent discloses each feature of claims 1, 3, 6, 7, 9, 11, and 13-15, and that a calcium carbonate opacifying agent is rendered obvious by the '084 patent. Applicants traverse these rejections.

"Anticipation requires a showing that each limitation of a claim is found in a single reference, either expressly or inherently." *Atofina v. Great Lakes Chemical Corp.*, 441 F.3d 991, 999 (Fed. Cir. 2006). Thus, a determination that a claim is anticipated under 35 U.S.C. § 102 involves two analytical steps. First, the U.S. Patent and Trademark Office (Patent Office) must interpret the claim language, where necessary, to ascertain its meaning and scope. In interpreting the claim language, the Patent Office is permitted to attribute to the claims only their broadest *reasonable* meaning as understood by persons having ordinary skill in the art, considered in view of the entire disclosure of the specification. *See In re Buszard*, 504 F.3d 1364 (Fed. Cir. 2007) (reversing a Patent Office decision that applied an unreasonably broad interpretation to a claim); *see also, In re Morris*, 127 F.3d 1048, 1054 (Fed. Cir. 1997). Second, the Patent Office must compare the construed claim to a single prior art reference and set forth factual findings that "each and every limitation is found either

expressly or inherently [disclosed] in [that] single prior art reference.” *Celeritas Techs. Ltd. v. Rockwell Int’l Corp.*, 150 F.3d 1354, 1360(Fed. Cir. 1998). Additionally, “[t]he identical invention must be shown in as complete detail as is contained in the patent claim.”

Richardson v. Suzuki Motor Co., 868 F.2d 1226, 1236 (Fed. Cir. 1989).

With further respect to a rejection under 35 U.S.C. §102(b), MPEP §2131 states:

"TO ANTICIPATE A CLAIM, THE REFERENCE MUST TEACH EVERY ELEMENT OF THE CLAIM"

'A claim is anticipated only if each and every elements as set forth in the claim is found, either expressly or inherently described, in a single prior art reference.' *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987)... 'The identical invention must be shown in as complete detail as is contained in the...claim.' *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989). The elements must be arranged as required by the claim, but this is not an *ipsissimis verbis* test, i.e., identity of terminology is not required. In *re Bond*, 910 F.2d 831, 15 USPQ2d 1566 (Fed. Cir. 1990)."

With respect to a determination that a claimed invention would have been obvious under §103(a), obviousness is a legal conclusion involving four factual inquiries: (1) the scope and content of the prior art; (2) the differences between the claimed invention and the prior art; (2) the differences between the claimed invention and the prior art; (3) the level of ordinary skill in the pertinent art; and (4) secondary considerations, if any, of non-obviousness. *Graham v. John Deere Co.*, 383 U.S. 1, 17-18 (1966). Secondary considerations of non-obviousness include factors such as commercial success, long-felt but unresolved needs, the failure of others, and/or unexpected results achieved by the claimed invention. *Id.* Obviousness is determined from the vantage point of a hypothetical person having ordinary skill in the art which the claimed subject matter pertains, who is presumed to have all prior art references in the field of the invention available to him/her. In *re Rouffet*, 149 F.3d 1350, 1357 (Fed. Cir. 1998). Furthermore, obviousness must be determined as of the time the invention was made and in view of the state of the art that existed at that time. *Uniroyal Inc. v. Rudkin-Wiley Corp.*, 837 F.2d 1044, 1050-51 (Fed. Cir. 1988).

The Patent Office must clearly articulate facts and reasons why the claimed invention "as a whole" would have been obvious to a hypothetical person having ordinary skill in the art at least as of the claimed invention's effective filing date. *KSR Int'l Co. v. Teleflex Inc.*, 127 S.Ct. 1727, 1741 (2007) (citing with approval *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006) ("[R]jections on obviousness grounds cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.")).' see also MPEP §2143 ("The key to supporting any rejection under 35 U.S.C. §103 is the clear articulation of reason(s) why the claimed invention would have been obvious.").

To reach a proper determination under 35 U.S.C. §103(a), the examiner must step backward in time and into the shoes worn by the hypothetical "person of ordinary skill in the art" when the invention was unknown and just before it was made. In view of all factual information, the examiner must then make a determination whether the claimed invention "as a whole" would have been obvious at that time to that person. Knowledge of applicants' disclosure must be put aside in reaching this determination, yet kept in mind in order to determine the "differences," conduct the search, and evaluate the "subject matter as a whole" of the invention. The tendency to resort to "hindsight" based upon applicants' disclosure is often difficult to avoid due to the very nature of the examination process. However, impermissible hindsight must be avoided and the legal conclusion must be reached on the basis of the *facts* gleaned from the prior art. MPEP §2142.

Furthermore, to establish a *prima facie* case of obviousness, the examiner must satisfy three requirements. First, as the U.S. Supreme Court very recently held in *KSR International Co. v. Teleflex Inc. et al.*, 127 S.Ct. 1727 (2007), "a court must ask whether the improvement is more than the predictable use of prior art elements according to their established functions. ...it [may] be necessary for a court to look to interrelated teachings of multiple patents; the effects of demands known to the design community or present in the marketplace; and the background knowledge possessed by a person having ordinary skill in the art, all in order to determine whether there was *an apparent reason* to combine the known elements in the fashion claimed by the patent at issue. ...it can be important to *identify a reason that would have prompted a person of ordinary skill in the relevant field to combine*

the elements in the way the claimed new invention does... because inventions in most, if not all, instances rely upon building blocks long since uncovered, and claimed discoveries almost of necessity will be combinations of what, in some sense, is already known." (emphasis added, *KSR, supra*). Second, the proposed modification of the prior art must have had a reasonable expectation of success, determined from the vantage point of the skilled artisan at the time the invention was made. *Amgen Inc. v. Chugai Pharm. Co.*, 18 USPQ2d 1016, 1023 (Fed. Cir. 1991). Lastly, the prior art references must teach or suggest all the limitations of the claims. *In re Wilson*, 165 USPQ 494, 496 (C.C.P.A. 1970).

As recently articulated by the Court of Appeals for the Federal Circuit in *Ortho-McNeil Pharmaceutical Inc. v. Mylan Laboratories Inc.*, 86 USPQ 2d, 1196, 1201-2 (Fed. Cir. 2008):

"As this court has explained, however, a flexible TSM test remains the primary guarantee against a non-statutory hindsight analysis such as occurred in this case. *In re Translogic Tech., Inc.* 504 F.3d 1249, 1257 [84 USPQ 2d 1929] (Fed. Cir. 2007) ("[A]s the Supreme Court suggests, a flexible approach to the TSM test prevents hindsight and focuses on evidence before the time of invention.)."

Once the Patent Office properly sets forth a *prima facie* case of obviousness, the burden shifts to the applicants to come forward with evidence and/or argument supporting patentability. *See In re Glaug*, 283 F.3d 1335, 1338 (Fed. Cir. 2002). Rebuttal evidence is merely a showing of facts supporting the opposite conclusion." *In re Piasecki*, 745 F.2d 1468, 1472 (Fed. Cir. 1984). Evidence rebutting a *prima facie* case of obviousness can include: (a) "evidence of unexpected results," *Pfizer, Inc. v. Apotex, Inc.*, 480 F.3d 1348 1369 (Fed. Cir. 2007); (b) "evidence that the prior art teaches away from the claimed invention in any material respect," *In re Peterson*, 315 F.3d 1325, 1331 (Fed. Cir. 2003); and, (c) evidence of secondary considerations, such as commercial success or long-felt yet unmet needs, *WMS Gaming, Inc. v. International Game Tech.*, 184 F.3d 1339, 1359 (Fed. Cir. 1999). The Patent Office must always consider such evidence supporting patentability. *See, e.g., In re Sullivan*, 498 F.3d 1345, 1352-53 (Fed. Cir. 2007) (reversing a Patent Office decision of obviousness because the Patent Office failed to consider the applicants' evidence rebutting a *prima facie* case of obviousness because the Patent Office failed to consider the applicants' evidence

rebutting a prima facie case of obviousness). If the Patent Office determines that such evidence is not compelling or is insufficient, then the Patent Office should specifically set forth the facts and reasoning supporting that determination. MPEP §2145 (8th Ed., Rev. 6, Sept. 2007).

The '084 patent discloses fire fighting compositions that contain a water-swellaable acrylic polymer, an inorganic solid, and water. The composition also may contain a colorant. The water-swellaable acrylic copolymers of the '084 patent are polyacrylamides (column 2, lines 33-59) or other water-swellaable polymer (column 4, lines 34-52). Contrary to the assertion of the examiner, the '084 patent does *not* disclose mixtures of a water-swellaable polymer with an additional opacifying polymers, such as those recited in element (c) of claims 1 and 11.

In particular, claims 1 and 11 require an additional opacifying agent selected from calcium carbonate (also claim 2) and various polymeric opacifying polymers (also claim 3). The examiner relies upon column 4, lines 34-53 of the '084 patent for teaching the additional polymeric opacifying agents recited in claims 1 and 11. The examiner misreads this portion of the '084 patent.

Column 4, lines 33-52 of the '084 patent states:

"In addition to the aforementioned water-swellaable acrylamide copolymers, other water-swellaable acrylic polymers useful herein include interpolymers of alkali metal acrylates and methacrylates reacted with a lightly cross-linking amount of a diethylenically unsaturated monomers copolymerizable therewith or cross-linking high energy ionizing radiation. *Also useful are lightly crosslinked polymers such as the above containing optional minor proportions, e.g., 0 up to 40 percent by weight or so of other monomers copolymerizable with sodium acrylate or acrylamide.* Suitable optional comonomers for the preparation of such interpolymers include N-vinyl-2-oxazolidinone, N-vinyl-pyrrolidone, sodium styrene sulfonate, potassium sulfoethyl acrylate to mention a few suitable water-soluble comonomers. Particularly preferred are essentially non-ionic and anionic comonomers. Also essentially water-insoluble comonomers can be used, such as styrene, methyl acrylate, ethyl methacrylate, acrylonitrile, vinyl acetate and the like." (emphasis added)

This paragraph of the '084 discloses *other* water-swellaable polymers that can be used *in place of* a polyamide homopolymer. Contrary to the contentions of the examiner, the 0-40% of other *monomers* disclosed in the above paragraph does *not* relate to 0-40% of a second or additional polymer used together with the polyacrylamide, but to *monomers* that can be copolymerized with acrylamide to provide an acrylamide copolymer.

The present claims recite an *additional* copolymer or calcium carbonate that is present in the fire-fighting composition in addition to the superabsorbent polymer. It should be further noted that the polymers of the claimed additional opacifying agent (and calcium carbonate) are not superabsorbent polymers.

Therefore, a difference exists between the present claims and the '084 patent, and on this basis alone, the '084 patent cannot anticipate the present claims under 35 U.S.C. §102(b).

In addition, the '084 patent discloses the use of a finely divided solid to decrease the mobility of a swollen gel, increase viscosity, and increase opacity ('084 patent, column 1, lines 54-59). Importantly, the finely divided solid stabilizes the polymer gel against light induced degradation.

At column 2, lines 1-21, the '084 patent discloses finely divided solids that can be used. The '084 patent discloses various finely divided solids at column 2, lines 3-5, including lead carbonate and calcium silicate. The examiner contends that the '084 patent teaches or suggests calcium carbonate because the reference discloses "silicate and carbonate metals of calcium and lead". This contention is incorrect.

The '084 patent teaches specific finely divided solids, and that the solid should be non-ionic, as defined in the '084 patent, column 2, lines 5-12, i.e., a resistivity of at least about 50,000 ohms for a slurry containing 0.2 weight percent of the solid, or else effective gel capacity of the polymer will be "substantially diminished" (column 2, lines 10-12). As discussed below, calcium carbonate fails to meet this '084 patent definition of a finely divided solid. Furthermore, the '084 patent fails to contain any generic disclosure with respect to

either carbonate and silicate or lead and calcium, or that the anions and cations of the compounds disclosed at column 2, lines 1-5 can be mixed and matched.

In summary, it is submitted that a difference exists between the '084 patent and claims 1, 3, 6, 7, 9, 11, and 13-15 because the '084 patent fails to teach *each* of a superabsorbent, colorant, additional polymer or calcium carbonate opacifying agent, and water. Therefore, the rejection of claims 1, 3, 6, 7, 9, 11, and 13-15 as being anticipated by the '084 patent under 35 U.S.C. §102(b) should be withdrawn. It also is submitted that these claims, and claim 2, would not have been obvious over the '084 patent. In particular, the examiner *incorrectly* contends that specific inorganic solids disclosed in the '084 patent are only "illustratively" named and that any similar solid would suffice (Office Action, page 4).

First, in order to establish a *prima facie* case of obviousness, the cited art must disclose or suggest each element recited in the claims. As discussed above, the '084 patent fails to teach or suggest an additional polymer that is present as an opacifying agent. The '084 patent teaches acrylamide homopolymer and other *water-swellaable* acrylic polymers, including acrylamide copolymers, that can be used in place of polyacrylamide.

In addition, the '084 patent provides no apparent reason for a person skilled in the art to modify the '084 patent disclosure and include an additional opacifying polymer, as presently claimed. The '084 patent cannot provide any reason, incentive, or motivation for a modification to include an additional polymeric opacifying agent because the '084 patent is totally silent with respect to additional polymeric agent in the composition.

In summary, the '084 patent fails to teach or suggest an additional opacifying polymer, that, as claimed, is *not* water-swellaable. Accordingly, the '084 patent cannot render the present claims obvious.

With respect to the recitation of calcium carbonate as the additional opacifying agent in claims 1 and 2, applicants submit that a substitution of calcium carbonate for the lead carbonate or calcium silicate disclosed in the '084 patent, in view of the definition given in the '084 patent for a finely divided solid, would not have been an obvious substitution.

Further, the '084 patent discourages, and leads persons skilled in the art away from, such a substitution.

The '084 patent discloses "finely divided, opaque and essentially non-ionic solids" (column 2, lines 1-2). As stated above, a "non-ionic solid" is defined in the '084 patent as one having a resistivity (of a 0.2 wt.% aqueous slurry) of at least about 50,000 ohms. Compounds that are salts composed of cations and anions fall under the term "non-ionic" because of the identity of compounds listed at column 2, lines 2-5 of the '084 patent. In fact, the term "non-ionic" in the '084 patent apparently is equivalent to "insoluble" in water because a soluble salt would exhibit an ionic conductivity and, in turn, a lower resistivity than *required* by the '084 patent. As stated above, a finely divided solid having a resistivity less than about 50,000 ohms adversely affects results (see '084 patent, column 2, lines 10-12).

The attached Exhibit A contains water solubilities for many of the finely divided solids disclosed in the '084 patent. Exhibit A contains data from the "Handbook of Chemistry and Physics," 51st edition, (1970) R.C. Weast, ed. and "The Merck Index," Ninth Edition (1976) M. Windholz et al. eds. It should be noted that lithopone ('084 patent, column 2, lines 3-4) is a mixture of barium sulfate and zinc sulfide, each of which is water insoluble, as shown in Exhibit A. As known in the art, powdered aluminum, diatomaceous earth, and silica gel have no water solubility. Exhibit A also contains the water solubility for the claimed calcium carbonate.

With respect to calcium silicate mentioned by the examiner, calcium silicate is insoluble in water, whereas calcium carbonate has a finite, but low, solubility (0.00153 g/100 ml or 0.0014 g/100 ml at 25°C for aragonite and calcite, respectfully, Exhibit A). On its face, this difference in solubility appears inconsequential, but this difference in solubility has practical ramifications. For example, for water contact construction purposes, portland cement mortar (which is in essence calcium silicate) is used rather lime mortar (which is in essence calcium carbonate) in order to impart sufficient water insolubility to the end product.

With respect to lead carbonate, lead carbonate (cerrusite) has a solubility of 0.00011 g/100 ml at 20°C (Exhibit A). Even disregarding that the atomic weight of lead is five times of calcium (which would reduce the ionic conductivity of a solution of the same

concentration in terms of mass even further) lead carbonate is one order of magnitude (i.e., 10 times) *less* soluble than calcium carbonate. Further, from the subject matter of the '084 patent, it can be inferred that the '084 patent is not referring to cerrusite, but basic lead carbonate ("white lead," mankind's oldest white pigment), which is insoluble in water. Consequently, the '084 patent disclosure is directed to highly insoluble (i.e., high resistivity), water insoluble solids, and calcium carbonate is excluded from this definition because its water solubility is too great.

The '084 patent teaches that the finely divided solids imparts definite properties to the composition. The '084 patent discloses the use of an insoluble solid to stabilize the water-swellaable polymer against degradation by sunlight, which in turn maintains gel viscosity for a longer time. Titanium dioxide, a known white, insoluble solid, performs the best by far in this regard. Accordingly, there is no incentive or apparent reason for a person skilled in the art to substitute a substantially more water soluble calcium carbonate for an insoluble solid disclosed in the '084 patent with any reasonable expectation of successfully maintaining gel viscosity.

The '084 patent therefore fails to teach or suggest every claimed element. The '084 patent disclosure is limited to highly insoluble solids having a resistivity of at least about 50,000 ohms for a 0.2 weight % dispersion. Calcium carbonate does not fall within this definition, and accordingly, is neither taught nor suggested by the '084 patent. To the contrary, the '084 patent discourages, and even leads skilled persons away from, the use of calcium carbonate in a composition of the '084 patent (see '084 patent, column 2, lines 10-12). A *prima facie* case of obviousness therefore cannot be maintained.

In summary, it is submitted that claims 1, 3, 6, 7, 9, 11, and 13-15 would not have been obvious over the '084 patent for all the reasons set forth above, and that the rejection of claim 2 under 35 U.S.C. §103 as being obvious over the '084 patent should be withdrawn.

Claims 4-6, 12, and 13 stand rejected under 35 U.S.C. §103 as being obvious over the '084 patent in view of Tanaka et al. U.S. Patent Publication No. 2002/0014610 ('610). Applicants traverse this rejection.

The patentability of the claims over the '084 patent has been discussed above. The '610 publication does not overcome the deficiencies of the '084 patent. The '610 publication relates to a different fire extinguishing mechanism than the present application. The presently-claimed *high-viscosity* superabsorbent gels maintain a quantity of water close to a combustible object, such as a house with a wildfire approaching. Opacity and color help fire fighters recognize whether the object is protected from a distance (such as from a fire-fighting plane). During a fire, the water evaporates, removes heat, and prevents burning of the object. If untouched by fire, the composition slowly dries and degrades. In short, a claimed composition is a fire-prevention composition.

In contrast, the '610 publication discloses a stable *low-viscosity* (see paragraph [0106]) composition that can be stored in a fire extinguisher and applied, as a foam, to extinguish a fire. The '610 publication therefore discloses a fire fighting composition (applied after fire ignition), which is different from a fire prevention composition (applied prior to fire ignition). In the '610 publication, a fluorine-based surfactant is combined with a water-soluble high molecular weight material (paragraphs [0008] and [0037] to [0087]). The '610 publication discloses polyethyleneimine as a water-soluble high molecular weight material for use *with* the surfactant and "a polybasic acid compound (C)" to "improve flame resistance and fuel resistance" ('610 publication, paragraph [0088]). Opacity is not an issue in the '610 patent, and is neither addressed nor considered.

Persons skilled in the art are aware of differences between fire prevention compositions and fire extinguishing compositions, and compounds used in one of the compositions for a particular function are not automatically used in the other type of composition. There simply is no apparent reason for a person skilled in the art to use a polyethylenimine of the '610 publication (in the absence of fluorinated surfactant and polybasic acid complex) directed to fire extinguishing compositions in a present fire prevention composition.

With respect to the examiner's statement directed to a pH modifier, the '610 publication at [0137] and nearby paragraphs do not disclose a pH modifier. The polybasic acid compound (C) [00134] functions as described above to complex with the polyethylenimine. See '610 publication, [0088].

Therefore, for the reasons set forth above with respect to the combined teachings of the '084 patent and the '610 publication, it is submitted that these references in combination fail to render claims 4-6, 12, and 13 obvious under 35 U.S.C. §103, and that the rejection should be withdrawn.

Claims 8-10 stand rejected under 35 U.S.C. §103 as being obvious over the '084 patent in view of Vandersall U.S. Patent Publication 2002/0013403 ('403 publication). Applicants traverse this rejection.

The patentability of the claims over the '084 patent has been discussed above. The '403 publication does not overcome these deficiencies.

The '403 publication discloses colorants to impart color to fire-fighting compositions. The '403 publication discloses yet a third type of fire-fighting composition, i.e., phosphate-containing compositions that are directly applied from planes or vehicles *onto* a fire. The '403 publication discloses the use of improved colorants to make these compositions visible from a distance and that comply with certain environmental regulations (paragraph [0022]). The '403 publication, however, is silent with respect to fire-protecting gels, as presently claimed and does not add anything to the '084 patent in this respect. It should also be noted that the '403 publication explicitly teaches away from using pigments such as titanium dioxide (paragraph [0023]) because the color of such pigments does not fade. Because pigments (i.e., highly insoluble solids) are central to the '084 patent disclosure, wherein titanium dioxide works best, the teachings of the '084 patent and the '403 publication are conflicting.

In short, claims 8-10 recite a preferred embodiment of the present invention. Applicants do not rely solely upon the features recited in claims 8-10 for patentability, but upon *all* the claimed features recited in claims 1 and 8-10. The '403 publication fails to overcome the deficiencies of the '084 patent, as set forth above with respect to claim 1.

It is submitted therefore that a combination of the '084 patent and the '403 publication fails to render claims 8-10 obvious under 35 U.S.C. §103, and that the rejection should be withdrawn.

All claims are in a form and scope for allowance. An early and favorable action on the merits is respectfully requested.

Should the examiner wish to discuss the foregoing, or any matter of form in an effort to advance this application toward allowance, the examiner is urged to telephone the undersigned at the indicated number.

Dated: July 2, 2009

Respectfully submitted,

By 

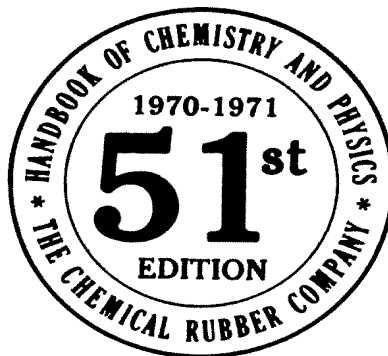
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Handbook OF Chemistry and Physics

A Ready-Reference Book of Chemical and Physical Data



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PHYSICAL CONSTANTS OF INORGANIC COMPOUNDS (Continued)

No.	Name	Synonyms and Formulas	Mol. wt.	Crystalline form, properties and index of refraction	Density or spec. gravity	Melting point, °C	Boiling point, °C	Solubility, in grams per 100 cc		
								Cold water	Hot water	Other solvents
a44	Aluminum nitrate	$\text{Al}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$	375.13	col, rhomb, deliq, 1.54		73.5	d 150	63.7 ^m	v e d	100 al; s alk, acet, HNO ₃ , a d a; alk
a45	nitride	AlN	40.99	wh cr, hex	3.26	>2200 (in N ₂)	subl 2000	d (NH ₃)	d	
a46	oleate (com'l)	$\text{Al}(\text{C}_{18}\text{H}_{35}\text{O}_2)_3$ (?)	871.37	wh powd, existence doubted except as basic salt				d		i al; v el s ba
a47	oxalate	$\text{Al}_2(\text{C}_2\text{O}_4)_3 \cdot 4\text{H}_2\text{O}$	390.08	wh powd				i	i	i al; s a
a48	oxide	Al_2O_3	101.96	col, hex, 1.768, 1.760	3.965 ^m	2045	2980	i		v al s a, alk
a49	oxide	α -Alumina, nat. corundum, Al_2O_3	101.96	col, rhomb cr, 1.765	3.97	2015 ± 15	2980 ± 60	0.000098 ^m	i	v al s a, alk
a50	oxide	γ -Alumina, Al_2O_3	101.96	wh micr cr, 1.7	3.5-3.9	tr to α		i	i	al s a, alk
a51	oxide, monohydrate	$\text{Al}_2\text{O}_3 \cdot \text{H}_2\text{O}$	119.98	col, rhomb, 1.624 ± 0.003	3.014			i	i	
a52	oxide, trihydrate	Nat. gibbsite, hydrargillite, $\text{Al}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$	156.01	wh monocr cr, 1.577, 1.577, 1.568	2.42	tr to $\text{Al}_2\text{O}_3 \cdot \text{H}_2\text{O}$ (Boehmite)		i	i	s h a, alk
a53	oxide, trihydrate	Nat. bayerite, $\text{Al}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$	156.01	wh micr cr, 1.583	2.53	tr to $\text{Al}_2\text{O}_3 \cdot \text{H}_2\text{O}$ (Boehmite)		i	i	s hot a, alk
a54	metaphosphate	$\text{Al}(\text{PO}_3)_3$	263.90	col, tetr	2.779			i	i	i a
a55	palmitate, mono- (com'l)	$\text{Al}(\text{OH})_3 \cdot \text{C}_{16}\text{H}_{33}\text{O}_2$	316.41	wh	1.095	200		i		s alk, hydrocarb
a56	1-phenol-4-sulfonate	$\text{Al}(\text{C}_6\text{H}_4\text{SO}_3)_3$	546.49	redsh-wh powd				s		s al, glyc
a57	phenoxide	$\text{Al}(\text{C}_6\text{H}_5\text{O})_3$	306.27	grayish-wh cr mass	1.23	d 265		d		s al, eth, chl
a58	orthophosphate	AlPO_4	121.95	wh rhomb pl, 1.546, 1.556, 1.578	2.566	>1500		i	i	s a, alk, al
a59	propoxide	$\text{Al}(\text{C}_3\text{H}_7\text{O})_3$	204.25	wh cr	1.0578 ^m	106	248 ^m	d	d	s al
a60	salicylate	$\text{Al}(\text{C}_7\text{H}_5\text{O}_3)_3$	438.33	redsh-wh powd				i		i al; s alk
a61	selenide	Al_2Se_3	290.84	lt brn powd, unstable in air	3.437 ^m			d	d	d a
a62	silicate	Nat. sillimanite, andalusite, cyanite, Al_2SiO_5	162.04	wh, rhomb, 1.66	3.247	1545 tr to $\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2$	>1545	i	i	d HF; i HCl; s fus alk
a63	silicate	Nat. mullite, $3\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2$	426.05	col, rhomb, 1.638, 1.642, 1.652	3.156	1920		i	i	i a, HF
a64	stearate, tri-	$\text{Al}(\text{C}_{18}\text{H}_{35}\text{O}_2)_3$	877.42	wh powd	1.010	103		i		s al, ba, turp, alk
a65	sulphate	$\text{Al}_2(\text{SO}_4)_3$	342.15	wh powd, 1.47	2.71	d 770		31.3 ^m	98.1 ^m	s dil a; al s al
a66	sulfate, hydrate	Nat. alunogenite, $\text{Al}_2(\text{SO}_4)_3 \cdot 18\text{H}_2\text{O}$	666.43	col, monocr, 1.474, 1.467, 1.483	1.69 ^m	d 86.5		86.9 ^m	1104 ^m	i al
a67	sulfide	Al_2S_3	150.16	yel, hex, odor H ₂ S, d moist air	2.02 ^m	1100	subl 1500 (N ₂)	d		s a; i acet
a68	thallium sulfate	Aluminum thallium alum., $\text{AlTi}(\text{SO}_4)_3 \cdot 12\text{H}_2\text{O}$	639.66	col, oct, 1.50112	2.325 ^m	91		4.84 ^m	65.19 ^m	
a69	Americium	Am	243.13	silvery, hex		>850	2600 (extrap)			s dil a
a70	bromide	AmBr_3	482.86	wh, orthorhomb		subl		s		
a71	chloride	AmCl_3	349.49	pink, hex	5.78	subl 850		s		
a72	fluoride	AmF_3	300.12	pink, hex	9.53			i		
a73	iodide	AmI_3	623.84	yel, orthorhomb	6.9			s		
a74	oxide	Am_2O_3	534.26	redsh-brn, cub or tan, or hex				s		s min a
a75	oxide, di-	Am_2O_3	275.13	blk, cub	11.68					s min a
a76	Ammonia	NH_3	17.03	col gas; liq, 0.817 ^m , 1.325 ^m	0.7710 g/ml; 760 mm	-77.7	-33.35	89.9	7.4 ^m	13.20 ^m al; s eth, org solv
a77	Ammonia-di-	Triduterio ammonia, ND_3	20.06			-74	-30.9			
v78	Ammonium acetate	$\text{NH}_4\text{C}_2\text{H}_3\text{O}_2$	77.08	wh cr, hydr	1.17 ^m	114	d	148 ^m	d	7.89 ^m MeOH; s al; al s acet
a79	acetate, hydrogen	$(\text{NH}_4)\text{H}(\text{C}_2\text{H}_3\text{O}_2)_2$	137.14	col need, deliq		66		s		s al
a80	aluminum chloride	$\text{NH}_4\text{Cl} \cdot \text{AlCl}_3$	186.83	wh cr		304		s		
a81	aluminum sulfate	$\text{NH}_4\text{Al}(\text{SO}_4)_2$	237.14	col, hex	2.45 ^m			s		s glyc; i al

No.	Name
a82	Ammonium aluminum hydrate
a83	orthoarsena-
a84	orthoarsena-
a85	orthoarsena-
a86	mono-H metarsenite
a87	arside
a88	benzene sul
a89	benzoate
a90	pentaborate
a91	peroxyborat
a92	tetaborate
a93	bromate
a94	bromide
a95	di-bromiodi
a96	bromoplatin
a97	bromoselen
a98	bromostann
a99	cadmium ch
a100	calcium arae
a101	calcium phos
a102	carbamate
a103	carbamate a
a104	carbonate
a105	carbonate, h
a106	cerium nitrat
a107	cerium nitrat
a108	cerium sulfat
a109	chlorate
a110	perchlorate
a111	chloride
a112	chloroaurate
a113	chloroaurate
a114	chlorogallate
a115	chloroiridate
a116	chloroiridite
a117	chloroosmate
a118	chloropallad
a119	chloropalladit
a120	hexachloropla
a121	chloroplatin
a122	chloroplumba
a123	chlorostannat
a124	tetrachlorosinc
a125	chromate
a126	dichromate
a127	peroxychroma
a129	chromium sulf
a130	citrate, di(sec)
a131	citrate, tri-(ter
a132	cobalt orthophosphate(ous)

Other solvents	No.	Name	Synonyms and Formulae	Mol. wt.	Crystalline form, properties and index of refraction	Density or spec. gravity	Melting point, °C	Boiling point, °C	Solubility, in grams per 100 cc		
									Cold water	Hot water	Other solvents
		Barium									
	b45	fluosilicate	BaSiF ₆	279.42	rhomb need	4.29 ⁿ _d	d 300		0.026 ¹⁷	0.09 ¹⁸	i al; al s a, NH ₄ Cl
	b46	formate	Ba(CHO ₂) ₂	227.38	ool, rhomb, 1.573, 1.597, 1.636	3.21	d		27.76 ²	39.71 ¹⁸	i al, eth
	b47	gluconate	Ba(C ₆ H ₁₁ O ₆) ₂ ·3H ₂ O	581.69	pr or rhomb leaf		-3H ₂ O, 100; d 120		3.3 ¹⁴		i al
	b48	hydride	BaH ₂	139.36	gray cr	4.21 ²	d 675	1400(?)	d to Ba(OH) ₂ + H ₂		d s
	b49	hydroxide	Ba(OH) ₂ ·8H ₂ O	315.48	ool, monocl, 1.471, 1.502, 1.50	2.18 ²	78	-8H ₂ O, 780	5.6 ¹⁴	94.7 ¹⁸	al s al; i acet
	b50	hyponitrite	BaN ₂ O ₂ ·4H ₂ O	269.41	wh cr powd	2.742 ²⁸					
	b51	iodate	Ba(IO ₃) ₂	487.15	monocl	4.998	d		0.006 ²	197 ¹⁸	s HNO ₃ , HCl
	b52	iodate, hydrate	Ba(IO ₃) ₂ ·H ₂ O	505.17	ool, monocl	4.657 ¹⁴	-H ₂ O, 200		v al s	al s	s HNO ₃ , HCl; i al, acet, H ₂ SO ₄
	b53	iodide	BaI ₂	391.15	ool cr	5.15 ¹⁴	740		170 ²		al 77 ¹⁸
	b54	iodide, hydrate	BaI ₂ ·2H ₂ O	427.18	ool rhomb, deliq	5.15	-H ₂ O, 98.9; -2H ₂ O, 539; d 740	200 ¹⁴	269 ¹⁸		1.07 ¹⁴ al; s acet
	b55	iodide, hydrate	BaI ₂ ·6H ₂ O	499.24	ool, hex		25.7		410 ²	v s	v s al
	b56	laurate	Ba(C ₁₂ H ₂₃ O ₂) ₂	535.97	wh leaf cr		260		0.008 ¹⁴	0.011 ¹⁸	0.008 ¹⁴ al; 0.008 ¹⁸ eth
	b57	l-malate	BaC ₄ H ₅ O ₆	269.41					0.883 ¹⁸	1.044 ¹⁸	
	b58	malonate	BaC ₂ H ₂ O ₄ ·H ₂ O	257.40					0.143 ²	0.320 ¹⁸	
	b59	manganate	BaMnO ₄	256.28	gray-grn, hex	4.85			v al s		s a
	b60	per-manganate	Ba(MnO ₄) ₂	375.21	br-vlt cr	3.77	d 200		62.5 ¹⁴	75.4 ¹⁸	d al
	b61	methylsulfate	Ba(CH ₃ SO ₄) ₂ ·2H ₂ O	395.56	ool eff cr				s		al s
	b62	molybdate	BaMoO ₄	297.28	wh powd	4.65	1480		0.0058 ¹⁸		al s a
	b63	myristate	Ba(C ₁₄ H ₂₇ O ₂) ₂	592.08					0.007 ¹⁸	0.010 ¹⁸	0.009 ¹⁴ al; 0.003 ¹⁸ eth 0.046 ¹⁴ MeOH
	b64	nitrate	Nitrobarite, Ba(NO ₃) ₂	261.35	ool cub, 1.572	3.24 ¹⁸	592	d	8.7 ¹⁸	34.2 ¹⁸	i al; al s a
	b65	nitride	BaN ₃	440.03	yel-br	4.783 ¹⁴		1000 vac	d	d	
	b66	nitrite	Ba(NO ₂) ₂	229.35	ool, hex	3.23 ¹⁸	d 217		67.5 ¹⁸	300 ¹⁸	al s al
	b67	nitrite, hydrate	Ba(NO ₂) ₂ ·H ₂ O	247.37	ool-yelah, hex	3.173 ¹⁸	d 115		63 ¹⁸	109.6 ¹⁸	1.6 al; v s HCl; i acet
	b68	oxalate	BaC ₂ O ₄	225.36	cr	2.658	d 400		0.0093 ¹⁸	0.0228 ¹⁸	i al; s NH ₄ Cl, s a dil a, al; i acet, NH ₃
	b69	oxide	BaO	153.34	ool, cub, wh-yelah powd, 1.98	5.72	1923	ca 2000	3.48 ¹⁸	90.8 ¹⁸	s dil a; i acet, s dil a; i al, eth, acet
	b70	oxide, per-	BaO ₂	169.34	wh-gray powd	4.96	450	-O, 800	v al s	d	s dil a; i acet
	b71	oxide, per-, hydrate	BaO ₂ ·8H ₂ O	313.46	ool, hex	2.292	-8H ₂ O, 100		0.168	d	s dil a; i al, eth, acet
	b72	palmitate	Ba(C ₁₆ H ₃₃ O ₂) ₂	648.19	wh cr powd		d		0.004 ¹⁸	0.007 ¹⁸	0.008 ¹⁴ al; 0.001 ¹⁸ eth
	b73	pyrophosphate	BaP ₂ O ₇	216.31	need				al s		s al; v al s a s a, NH ₄ Cl
	b74	orthophosphate di-	BaHPO ₄	233.32	wh, rhomb, 1.635, 1.617	4.168 ¹⁴	d 410 ¹⁸		0.01-0.02		
	b75	orthophosphate, mono-	Ba(H ₂ PO ₄) ₂	331.31	tricl	2.9 ²			d	d	s a
	b76	orthophosphate, tri-	Ba ₃ (PO ₄) ₂	601.96	wh, cub	4.1 ¹⁴			i	i	s a
	b77	pyrophosphate	Ba ₂ P ₂ O ₇	448.62	wh, rhomb	3.9 ¹⁸			0.01	al s	s a, NH ₄ salts
	b78	hypophosphite	Ba(H ₂ PO ₃) ₂ ·H ₂ O	285.33	wh, monocl	2.90 ¹⁷	d 100-150		30 ¹⁴	33 ¹⁸	i al
	b79	propionate	Ba(C ₃ H ₇ O ₂) ₂ ·H ₂ O	301.80	rhomb, β 1.518		d 300		48 ²	67.9 ¹⁸	0.06 al
	b80	salicylate	Ba(C ₇ H ₅ O ₃) ₂ ·H ₂ O	437.65	wh need				s		
	b81	selenate	BaSeO ₄	280.30	wh, rhomb	4.75	d		0.0118	0.138 ¹⁸	s HCl; i HNO ₃
	b82	selenide	BaSe	216.30	wh cub disc, η_D , 2.268	5.02			d	d	d HCl
	b83	metasilicate	BaSiO ₃	213.42	ool, rhomb, 1.673, 1.674, 1.678	4.399	1604		i	d	s HCl
	b84	metasilicate, hydrate	BaSiO ₃ ·6H ₂ O	351.52	rhomb, 1.542, 1.548, 1.548	2.89			0.17	d	
	b85	stearate	Ba(C ₁₈ H ₃₅ O ₂) ₂	704.13	wh powd				0.004 ¹⁴	0.006 ¹⁸	0.005 ¹⁴ al, 0.008 ¹⁸ al, 0.001 ¹⁸ eth
	b86	succinate	BaC ₄ H ₄ O ₄	253.37	wh powd				0.421 ²	0.237 ¹⁸	al s al
	b87	sulfate	Nat. barite, prec. blanc fixe, BaSO ₄	233.40	wh, rhomb (monocl), 1.637, 1.638, 1.649	4.50 ¹⁴	1580	tr 1149 monocl	0.000222 ¹⁸	0.000336 ¹⁸	0.006 s 3% HCl; al s H ₂ SO ₄
	b88	peroxydisulfate	Ba ₂ S ₂ O ₈ ·4H ₂ O	401.52	wh, monocl		d		52.2 ²	d	d al
	b89	sulfide, hydro-	Ba(SH) ₂ ·4H ₂ O	275.56	yel, rhomb		d 50		s		i al
	b90	sulfide, mono-	BaS	169.40	ool, cub, η_D 2.155	4.25 ¹⁴	1200		d	d	i al
	b91	sulfide, tetra-	BaS ₄ ·H ₂ O	283.61	red or yel, rhomb	2.988	d 300		41 ¹⁴	v s	i al, CS ₂
	b92	sulfide, tri-	BaS ₃	233.53	yel-grn cr		d 554		s	s	

PHYSICAL CONSTANTS OF INORGANIC COMPOUNDS (Continued)

rains per 100 cc	No.	Name	Synonyms and Formulae	Mol. wt.	Crystalline form, properties and index of refraction	Density or spec. gravity	Melting point, °C	Boiling point, °C	Solubility, in grams per 100 cc		
									Cold water	Hot water	Other solvents
Other solvents											
		Calcium									
s a, NH ₃	c87	butyrate	Calc. 4H ₃ O ₂ ·3H ₂ O	268.32	col. cr.				s	sl s	
	c88	carbide	CaC ₂	64.10	col. metr. 1.75	2.22	stab. 25-447	2300	s	sl s	
l al, eth; s HCl	c89	carbonate	Nat. aragonite, CaCO ₃	100.09	col. rhomb. 1.530-1.681, 1.685	2.930	tr. to calcite 520	d 825	0.00153 ⁹	0.00190 ⁹	s a, NH ₄ Cl
s d HCl, s exp conc HNO ₃	c90	carbonate	Nat. calcite, CaCO ₃	100.09	col. rhomb. or hex. 1.6583, 1.4864	2.710 ⁹	13,900 ⁹	d 898.5	0.00143 ⁹	0.00185 ⁹	s a, NH ₄ Cl
l al	c91	carbonate, hexa-hydrate	CaCO ₃ ·6H ₂ O	208.18	col. monoc. 1.160, 1.535, 1.515	1.771 ⁷					
s al, eth, glycerol	c92	chlorate	Ca(ClO ₃) ₂	206.99	wh. cr. hyg.		410-410		s	s	s al, acet
s, NH ₄ OH	c93	chlorate, dihydrate	Ca(ClO ₃) ₂ ·2H ₂ O	243.01	wh. yelsh. rhomb. or monoc. deliq.	2.711	110		177.75	v s	s al, acet
	c94	perchlorate	Ca(ClO ₄) ₂	238.98	col. cr.	2.651	d 270		188.6	v s	100.2 ⁹ al; 237.4 MeOH
d a	c95	chloride	CaCl ₂	110.99	col. cub. deliq. 1.52	2.15 ²	772	-1900	74.5	1500 ⁹	s al, acet, acetic
	c96	chloride dibromate	BrCaO ₂ AlO ₂ CaCl ₂ ·10H ₂ O	664.44	col. monoc. or hex. 1.550-1.555	1.892 ⁹	110-105	811.0-150	sl s	d	s a
l al, acet, NH ₃	c97	chloride, dihydrate	CaCl ₂ ·2H ₂ O	147.02	col. cr.	0.84			97.7	426 ⁹	50% al
l al	c98	chloride, hexa-hydrate	CaCl ₂ ·6H ₂ O	219.08	col. trig. deliq. 1.417-1.463	1.71 ⁹	29.92	411.0-30-411.0, 200	279 ⁹	246 ⁹	s al
s a; v sl s NH ₄ OH	c99	chloride, mono-hydrate	CaCl ₂ ·H ₂ O	129.00	col. cr. deliq.		260		76.8 ⁹	249 ⁹	s al, acet
l al; s a, NH ₄ OH	c100	chloride fluoride	BrCaFPO ₄ CaF ₂	402.508	col. cr. 1.614, 1.611	1.44	1270		v sl s		
s a, NH ₄ OH	c101	chloride	Ca(ClO ₂) ₂	173.98	wh. cub.	2.71			d	d	l al
s; d HNO ₃	c102	hypochlorite	Ca(ClO) ₂	142.98	wh. powd. or tab. pl. 1.515, 1.59	2.55	1400		s		l al
l NH ₄ OH	c103	chloride, basic	Ca(ClO ₂) ₂ ·2Ca(OH) ₂	347.46	wh. hex. 1.41	2.40			sl s solns. with 5-6% avarol	d	d a
0.037 conc NH ₄ OH	c104	hypochlorite, basic	Bleaching powder, chlorinated lime, Ca(ClO) ₂ ·Ca(OH) ₂ ·CaCl ₂ ·2H ₂ O	comp. varies	wh. powd. strong Cl odor		d		d exh. Cl ₂		d a
	c105	hypochlorite, tri-hydrate	Ca(ClO) ₂ ·3H ₂ O	197.03	tr. pl. 1.415-1.5	2.4		411.0-60			
	c106	chromate	CaCrO ₄ ·2H ₂ O	192.09	col. monoc. pr.		211.0-200		16.4 ⁹	18.2 ⁹	s al, al
	c107	chromite	CaCr ₂ O ₄	208.07	col. grn. cub. need.	1.85	2090				car. solns. K ₂ CO ₃
	c108	cinnamate	CaC ₉ H ₇ O ₂ ·3H ₂ O	388.41	col. cr.				0.225	1.341 ⁹	
	c109	citrate	Ca(C ₆ H ₅ O ₇) ₂ ·H ₂ O	570.44	wh. need.			111.0-120	0.85 ⁹	0.06 ⁹	0.0065 ⁹ al
	c110	cyanamide	CaCN ₂	80.10	col. trig. cub. tr.		1300-1010		d exl. NH ₄ al		
	c111	cyanide	Ca(CN) ₂	92.12	wh. powd.		d 450		d	d	
	c112	cyanoplattinite	CaPt(CN) ₄ ·5H ₂ O	426.51	col. grn. fibrous, rhomb. 1.9226		511.0-100		s		
	c113	ferrocyanide	Ca ₄ [Fe(CN) ₆]·12H ₂ O	760.42	red. need. deliq.				v s	v s	
	c114	ferrite, mono	Ca ₂ FeO ₄	215.77	dk. redsh. rhomb. 2.58, 2.43 CN ₂	5.08	1250		d		v sl s a
	c115	ferrocyanide	Ca ₄ [Fe(CN) ₆] or 12H ₂ O	490.28	col. trid. 1.570, 1.582, 1.596	1.68	d		86.8 ⁹	115 ⁹	l al
	c116	fluosilicate	CaSiF ₆	182.16	col. metr.	2.60 ⁹			sl s		s al, HF, HCl
	c117	fluoride	Nat. fluorite, CaF ₂	78.08	col. cub. lustrous, w. heat 1.134	3.180	1550	or 2500	0.00165 ⁹	0.0017 ⁹	s NH ₄ salt; sl s a, acet
l; s h HNO ₃	c118	fluosilicate, dihydrate	CaSiF ₆ ·2H ₂ O	218.19	col. tetrag.	2.254			sl s d		s HCl, HF; l al
11% al; l eth	c119	formate	CaC(HO) ₂	130.12	col. rhomb. 1.510, 1.514, 1.578	2.015	d		16.2 ⁹	18.1 ⁹	l al
	c120	fumarate	CaC ₄ H ₂ O ₆ ·3H ₂ O	208.18	col. rhomb.				2.11 ⁹		
	c121	gluconate	CaC ₆ H ₁₁ O ₇ ·H ₂ O	448.40	wh. or powd. need.		1170		5.3 ⁹		v sl s al
	c122	glycerophosphate	CaC ₃ H ₅ O ₇ ·H ₂ O	210.16	wh. or powd. hyg.		d 170		2 ⁹		l al
	c123	hydride	CaH ₂	42.10	wh. rhomb. cr.	1.9	870 (m H ₂)		d H ₂		d a
	c124	hydroxide	Ca(OH) ₂	74.09	col. hex. 1.571, 1.545	2.24	-11.0-380	d	0.185 ⁹	0.077 ⁹	s NH ₄ salts, a; l al
	c125	hyponitrite	CaN ₂ O ₂ ·H ₂ O	172.15	wh. cr.	1.834	d 320				d dil a
	c126	iodate	Nat. iantinite, Ca(IO ₃) ₂	389.89	col. monoc.	1.519 ⁹	d 540		0.20 ⁹	0.07 ⁹	s HNO ₃ ; l al
l, MeOH	c127	iodate, hexa-hydrate	Ca(IO ₃) ₂ ·6H ₂ O	497.98	col. rhomb.		d 35		0.13 ⁹	1.22 ⁹	s HNO ₃
acet, a	c128	iodide	CaI ₂	293.89	yelsh. wh. hex. deliq.	3.956 ²	740	or 1100	209 ⁹	126 ⁹	126 ⁹ MeOH; s al, acet, a

PHYSICAL CONSTANTS OF INORGANIC COMPOUNDS (Continued)

No.	Name	Synonyms and Formulae	Mol. wt.	Crystalline form, properties and index of refraction	Density or spec. gravity	Melting point, °C	Boiling point, °C	Solubility, in grams per 100 cc		
								Cold water	Hot water	Other solvents
c369	Chlorine	Cl ₂	70.906	grnsh-yel gas, or liq. or rhomb cr; gas 1.000768, liq 1.367	3.214 ^o	-100.98	-34.6	310 ^o cm ³ 1.46 ^o g	177 ^o cm ³ 0.57 ^o g	s alk
c370	arside	chlor(o)arside ClAs	77.48	gas, expl				al s		d alk
c371	fluoride, mono-	ClF	54.45	col gas	1.62 ^o	-154 ± 5	-100.8	d	d	
c372	fluoride, tri-	ClF ₃	92.45	col gas	1.77 ^o	-83	11.3	d	d	
c373	hydrate	Cl ₂ ·8H ₂ O	215.03	lt yel, rhomb	1.23	d 9.6				s alk
c374	oxide, di-	ClO ₂	67.45	yel red gas, or red cr, expl	3.09 ^o g/l	-59.5	9.9 ^o exp	2000 ^o cm ³	d to HClO ₂ , Cl ₂ , O ₂	s alk, H ₂ SO ₄
c375	oxide, hept-	Cl ₂ O ₇	182.90	col oil		-91.5	82	s d		s bz
c376	oxide, mono-	Cl ₂ O	86.91	yel-red gas, or red-br liq	3.89 ^o g/l	-20	3.8 ^o exp	200 cm ³	d to HOCl	s alk, H ₂ SO ₄
c377	oxide, tetr-	ClO ₄ or Cl ₂ O ₈	99.45				d	s d		s bz
c378	chlorosauric acid	HAuCl ₄ ·4H ₂ O	411.85	brt yel need, deliq		d		s	v s	s al, eth
c379	chloroplatinic acid	H ₂ PtCl ₆ ·6H ₂ O	517.92	red br pr, deliq	2.431	60		v s	v s	s al, eth
c380	chlorostannic acid	H ₂ SnCl ₆ ·6H ₂ O	441.52	col leaf	1.93	9		s		
c381	Chlorosulfonic acid	ClSO ₃ H	116.52	col fum liq, 1.437 ^o	1.766 ^o	-80	158	d to H ₂ SO ₄ , HCl		d al, a; i CS ₂
c382	Chlorotetroxy fluoride	ClO ₄ F	118.45	col gas, v exp		-167.3	-15.9			
c383	Chloryl (per-)fluoride	ClO ₃ F	102.45	gas	1.392 ^o	-146	-46.8			
c384	Chromium	Cr	51.996	steel gray, cub v hard	7.20 ^o	1890	2482			s dil H ₂ SO ₄ , HCl; i HNO ₃ , aq reg
c385	(II) acetate	Cr(C ₂ H ₃ O ₂) ₃	170.09	red cr				al s		al s al
c386	(III) acetate	Cr(C ₂ H ₃ O ₂) ₃ ·H ₂ O	247.15	gray-grn powd or blsh-grn pasty mass				s		al
c387	arsenide, mon-	CrAs	126.92	gray, hex	6.35 ^o					i a
c388	boride, mono-	CrB	62.81	silv cr, orthorhomb	6.17	2760(?)				s fus Na ₂ O ₂
c389	(II) bromide	CrBr ₂	211.81	wh cr	4.356	842				s al
c390	(III) bromide	CrBr ₃	291.72	olv gr, hex	4.250 ^o	subl				v s al; d alk
c391	bromide, hexahydrate	[CrBr ₃ (H ₂ O) ₃]·2H ₂ O	399.81	grn cr, deliq						s tr to vlt
c392	bromide, hexahydrate	[Cr(H ₂ O) ₃]Br ₃	399.81	blsh gray to vlt	5.4 ^o			v s	v s	al
c393	(tri-)carbide, di-	Cr ₂ Cr	180.02	gray, rhomb	6.68	1890	3800			
c394	carbonyl	Cr(CO) ₅	220.06	col, orthorhomb	1.77	d 110	210 exp			i al, eth, ac a; al s CH ₃ , CCl ₄
c395	(II) chloride	CrCl ₂	122.90	wh need, deliq	2.878 ^o	824		v s	v s	i al, eth
c396	(III) chloride	CrCl ₃	158.35	vlt, trig	2.76 ^o	ca 1150	subl 1300		al s	i al, acet, MeOH, eth
c397	chloride, hexahydrate	[Cr(H ₂ O) ₆]Cl ₃ ·2H ₂ O	266.45	vlt, monocl	1.76	83		58.5 ^o		s al; i eth; al s acet
c398	(II) fluoride	CrF ₂	89.99	grn, cr, monocl	4.11	1100	>1300	al s		i al; s h HCl
c399	(III) fluoride	CrF ₃	108.99	grn, rhomb	3.8	>1000	subl 1100-1200			i al, NH ₃ ; al s a; s HF
c400	(II) hydroxide	Cr(OH) ₂	86.01	yel-br		v		d		s a
c401	iodate, hydrate	[Cr(H ₂ O) ₃]I ₃ ·3H ₂ O	594.85	dk vlt cr, hyg	4.915 ^o	41-HI		v s	v s	s al, acet; i CHI
c402	(II) iodide	CrI ₂	305.80	graysh powd	5.196	856	subl vac 800			
c403	(III) iodide	CrI ₃	432.71	shiny blk cr	4.915 ^o	>600	-I ₂ , vac 350			
c404	(III) nitrate	Cr(NO ₃) ₃ ·7H ₂ O	373.13	br, monocl		100	d	s		s a, alk, al, acet
c405	(III) nitrate	Cr(NO ₃) ₃ ·9H ₂ O	400.15	purple, monocl		60	d 100	s		al s aq reg
c406	nitride, mono-	CrN	66.00	cub or amorph	5.9	d 1700				s dil a
c407	(II) oxalate	CrC ₂ O ₄ ·H ₂ O	158.03	yel cr powd	2.468			al s		v s (red) al, eth; i (grn) al
c408	(III) oxalate	Cr ₂ (C ₂ O ₄) ₃ ·6H ₂ O	476.14	red, amorph, hyg		120, -H ₂ O tr to grn		s		s HNO ₃
c409	oxide, di-	Cr ₂ O ₃	84.00	br-blk powd		300, -O				i dil HNO ₃
c410	(II) oxide, mon-	CrO	68.00	blk powd						i a, alk, al
c411	(III) oxide, sesqui-	Cr ₂ O ₃	151.99	grn, hex, 2.551	5.21	2435	4000			s a, alk; al s NH ₄ OH
c412	(III) oxide, sesqui-	Cr ₂ O ₃ ·xH ₂ O	varies	vlt, amorph or bl-gray grn gel						s al, eth, H ₂ SO ₄
c413	oxide, tri-	Chromic anhydride, "chromic acid", CrO ₃	99.99	red, rhomb, deliq	2.70	196	d	61.7 ^o	67.45 ^o	HNO ₃
c414	oxychloride	CrO ₂ Cl ₂	154.90	dk red liq	1.911	-96.5	117	d	d	d al; s eth, ac a
c415	2,4-pentandione	Chromium acetylacetonate, Cr(C ₅ H ₇ O ₂) ₃	349.33			216	340			s org solv; i lgr

PHYSICAL CONSTANTS OF INORGANIC COMPOUNDS (Continued)

No.	Name	Synonyms and Formulae	Mol. wt.	Crystalline form, properties and index of refraction	Density or spec. gravity	Melting point, °C	Boiling point, °C	Solubility, in grams per 100 cc		
								Cold water	Hot water	Other solvents
Lead										
142	borofluoride	Pb(BF ₃) ₂	380.80	cr pr				d		d al
143	bromate	Pb(BrO ₃) ₂ ·H ₂ O	481.02	col, monoc	5.53	d 180		1.38 ²⁰	sl s	
144	bromide	PbBr ₂	367.01	wh, rhomb	6.66	373	916	0.4554 ²⁰ 0.8441 ²⁰	4.71 ¹⁰⁰	s a, KBr; sl s NH ₃ ; i al s dil HNO ₃
145	butyrate	Pb(C ₄ H ₇ O ₂) ₂	381.39	col scales, pois		90		i	i	s dil HNO ₃
146	caprate	Pb(C ₁₀ H ₁₉ O ₂) ₂	549.71			103-104		i	i	0.0020 ²⁰ eth
147	caproate	Pb(C ₆ H ₁₁ O ₂) ₂	437.50			73-74		i	i	1.09 ²⁰ eth
148	caprylate	Lead octoate. Pb(C ₈ H ₁₅ O ₂) ₂	493.60	wh leaf		83.5-84.5		i	i	s al; 0.0938 eth
149	carbonate	Nat. cerussite. PbCO ₃	267.20	col, rhomb, 1.804, 2.076, 2.078	6.6	d 315		0.00011 ²⁰	d	s a, alk; i NH ₃ , al
150	carbonate, basic	White lead, hydrocerussite. 2PbCO ₃ ·Pb(OH) ₂	775.60	wh powd, or hex	61.4	d 400		i	i	sl aq CO ₂ ; s HNO ₃ ; i al
151	cerotate	Pb(C ₂₁ H ₄₁ O ₂) ₂	998.57	wh need		113		i		i al, eth; s bs
152	chlorate	Pb(ClO ₃) ₂	374.09	wh monoc, deliq	3.80	d 230		v s		s al
153	chlorate, hydrate	Pb(ClO ₃) ₂ ·H ₂ O	392.11	wh, monoc, deliq	4.037	d 110		151.3 ¹⁸	171 ²⁰	s al
154	perchlorate	Pb(ClO ₄) ₂ ·3H ₂ O	460.14	wh, rhomb	2.6	d 100		490.7 ²⁰		s al
155	chloride	Nat. cotunnite. PbCl ₂	278.10	wh, rhomb, 2.190, 2.217, 2.260	5.85	501	950 ²⁰	0.99 ²⁰	3.34 ¹⁰⁰	sl s dil HCl, NH ₃ ; i al; s NH ₃ salts
156	chloride, tetra-	PbCl ₄	349.00	yel oily liq	3.18 ²⁰	-15	expl 105	d (Cl ₂)	d	s conc HCl
157	chloride, sulfide	PbCl ₂ ·3PbS	995.86	red				i	d	d a, alk; i dil a
158	chlorite	Pb(ClO ₂) ₂	342.09	yel, monoc		expl 126		0.095 ²⁰	0.42 ²⁰	s KOH
159	chromate	Nat. crocoite, chrome yellow. PbCrO ₄	323.18	yel, monoc, 2.31, 2.37 (Li), 2.66	6.12 ¹⁸	844	d	0.0000068 ²⁰	i	s a, alk; i ac a, NH ₃
160	chromate, basic	Chrome red. PbCrO ₄ ·PbO	546.37	red or powd	6.63			i	i	s a, alk
161	chromate, basic	Pb ₂ (OH) ₂ CrO ₄	564.39	red amorph or cr	6.63	920		i	i	s KOH
162	dichromate	PbCr ₂ O ₇	423.18	red or				d		s a, alk
163	citrate	Pb ₃ (C ₆ H ₅ O ₇) ₂ ·3H ₂ O	1053.82	wh or powd				s		v sl s al
164	cyanate	Pb(OCN) ₂	291.22	wh need		d		i	sl s	
165	cyanide	Pb(CN) ₂	250.23	yelish-wh powd, pois				sl s	s	s KCN
166	emanthate	Pb(C ₇ H ₁₅ O ₂) ₂	465.55	wh leaf		91.5		sl s		i al
167	ethylsulfate	Pb(C ₂ H ₅ SO ₄) ₂ ·2H ₂ O	493.57	col liq, pois				s		
168	ferricyanide	Pb ₂ [Fe(CN) ₆] ₃ ·5 (or 6) H ₂ O	1135.55	blk-brn to red, monoc pr		-H ₂ O, 110-120 d		sl s	s, d 100	s alk, HNO ₃
169	ferrite	PbFeO ₃	382.88	hex		1530 d, 725		i		sl s H ₂ SO ₄
170	ferrocyanide	Pb ₂ [Fe(CN) ₆] ₃ ·3H ₂ O	680.38	yelish-wh powd		-H ₂ O, 100		i		s HNO ₃ ; i aq, NH ₃
171	fluoride	PbF ₂	245.19	col, rhomb, pois	8.24	855	1290	0.064 ²⁰		
172	fluorochloride	Nat. matlockite. PbFCl	261.64	wh, tetr, 2.145, 2.006	7.05	601		0.037 ²⁰	0.1081 ¹⁰⁰	
173	fluosilicate	PbSiF ₆ ·3H ₂ O	385.30	col, monoc		d		s	v s	
174	fluosilicate, tetra-	PbSiF ₆ ·4H ₂ O	421.33	col, monoc		d < 100				
175	formate	Pb(CHO ₂) ₂	297.23	wh, rhomb, lust, 1.780, 1.852, 1.877	4.63	d 190		1.6 ¹⁸	20 ²⁰	i al
176	hydride, di-	PbH ₂	209.21	gray powd		d				
177	hydroxide	Pb(OH) ₂	241.20	wh, amorph		d 145		0.0155 ²⁰	sl s	s a, alk; i ac a
178	hydroxide	PbO(OH) ₂ or 2PbO·H ₂ O	464.39	wh cub, or amorph powd, pois	7.592	d 145		0.014	sl s	s alk, ac a, HNO ₃
179	iodate	Pb(IO ₃) ₂	557.00	wh	6.153 ²⁰	d 300		0.0012 ²⁰	0.003 ¹⁸	sl s HNO ₃ ; i NH ₃
180	periodate	PbHIO ₄	415.10	wh cr		d 130		i	i	s dil HNO ₃
181	periodate, hydrate	PbHIO ₄ ·H ₂ O	433.11	amorph		-H ₂ O, 110		i	i	sl s dil HNO ₃
182	iodide, basic	PbI ₂ ·PbO·H ₂ O	702.20	rhomb cr	6.83 ²⁰	d 100				
183	iodide, di-	PbI ₂	461.00	yel hex powd, pois	6.16	402	954	0.044 ²⁰ 0.063 ²⁰	0.41 ¹⁰⁰	s alk, KI; i al
184	iodide, mono-	PbI	334.09	pa yel		d 300		0.1		
185	isobutyrate	Pb(C ₄ H ₇ O ₂) ₂	381.39	wh pr		< 100		9.1 ¹⁸		s h al
186	lactate	Pb(C ₃ H ₅ O ₂) ₂	385.33	wh or powd				s		0.008 ²⁰ al;
187	laurate	Pb(C ₁₂ H ₂₃ O ₂) ₂	605.82	chalky wh powd		104.7		0.009 ²⁰		0.007 ¹⁸ eth
188	lignocenate	Pb(C ₁₁ H ₁₉ O ₂) ₂	942.47	wh powd		117		i		v s h bz; sl s al; i eth
189	malate	Pb(C ₄ H ₅ O ₂) ₂ ·3H ₂ O	393.31	wh powd				sl s		v sl s al
190	melissate	Pb(C ₁₃ H ₂₁ O ₂) ₂	1138.85	wh powd		115-116		i	i	s boil tol, ac a; sl s h bz, chl; i al, eth
191	molybdate	Nat. wulfenite. PbMoO ₄	367.13	col-lt yel, tetr pl	6.92 ²⁰	1060-1070				d conc H ₂ SO ₄ ; s a, KOH; i al
192	myristate	Pb(C ₁₄ H ₂₇ O ₂) ₂	661.93	wh powd		107		0.005 ²⁰	0.006 ²⁰	0.004 ²⁰ al; 0.010 ¹⁸ eth

PHYSICAL CONSTANTS OF INORGANIC COMPOUNDS (Continued)

grams per 100 cc

Other solvents

conc

alk

conc

hot aq reg

alk sol

conc a

acid

sol a

alk acid sol

alk a

alk a

aq reg, alk, sl s

dil HNO₃

aq reg, alk, sl s

dil HNO₃

aq reg, alk, sl s

dil HNO₃

aq reg, alk, sl s

dil HNO₃

sol dil HCl

conc a

sol, eth, acet

acet, PCl₅

AcBr

sol, eth, acet

et acet, me

acet, pyr

sol, eth, acet

glycol a

eth

alk

alk

alk

alk

alk

alk

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No.	Name	Synonyms and Formulas	Mol. wt.	Crystalline form, properties and index of refraction	Density or spec. gravity	Melting point, °C	Boiling point, °C	Solubility, in grams per 100 cc		
								Cold water	Hot water	Other solvents
Tin										
t208	(II) nitrate	Sn(NO ₃) ₂ · 10H ₂ O	603.07	col leaf		1-20		d	d	d HNO ₃
t209	(II) nitrate, basic	SnO · Sn(NO ₃) ₂	377.39	wh or mass		d > 100 expl		d	d	
t210	(IV) nitrate	Sn(NO ₃) ₄	369.71	silky mass		d 50		d	d	
t211	(II) oxide, mon	SnO	151.09	blk, cub, tetra	6.416	d 1080°				s a, alk, sl s
t212	oxide, mon-hydrate	SnO · xH ₂ O		wh, powd or yellow-brown or						NH ₄ Cl
t213	(IV) oxide, di	Nat. cassiterite, SnO ₂	150.69	wh, terr, false hex 6.95 or rhombic 1.997, 2.093		1127	subl 1800-1900			d to SnO
t214	oxide, di-hydrate	α-Stannic acid or "ordinary" stannic acid, SnO ₂ · xH ₂ O		amorph or gel						carb; i NH ₄ OH
t215	oxide, di-hydrate	β-Stannic acid or "meta" stannic acid, SnO ₂ · xH ₂ O		wh, amorph or gel						d KOH, NaOH, i aq reg
t216	(II) metaphosphate	Sn ₂ (PO ₃) ₄	276.61	amorph mass	3.807					s a, alk, K ₂ CO ₃
t217	(II) orthophosphate	Sn ₃ (PO ₄) ₂	516.01	wh, amorph	3.820					s a, alk
t218	(II) orthophosphate, di H	Sn ₂ H ₂ (PO ₄) ₂	312.66	wh, rhombic	3.1673	d	d			
t219	(II) orthophosphate, mono H	SnH ₂ (PO ₄) ₂	214.67	cr	3.1703	stabl > 100	d			s dil min a
t220	(II) pyrophosphate	Sn ₂ P ₂ O ₇	411.32	amorph powd	4.069					s conc a
t221	phosphide, mono-	SnP	149.66	sil, wh	6.56	d	d			s HCl, i HNO ₃
t222	phosphide, tri-	SnP ₃	213.61	cr	4.109	> 115.4 to SnP ₂				d HNO ₃ , i HCl
t223	tetraphosphide, tri-	Sn ₃ P ₄	567.68	wh, cr	5.181	d < 180				d fixed alk hydr, HCl
t224	phosphorus chloride	SnCl ₄ · 4P ₂ Cl ₅	168.74	col, cr		subl 200		d	d	
t225	(II) selenide	SnSe	197.63	steelgray, cr	6.179	891				d HCl, HNO ₃
t226	(II) sulfate	Sn(SO ₄) ₂	214.75	wh, cub or powd		> 360 (SO ₃)		332		aq reg, alk sulf
t227	(IV) sulfate	Sn(SO ₄) ₂ · 2H ₂ O	316.84	wh, hex pr, deliq				v s	d	s H ₂ SO ₄
t228	(II) sulfide	SnS	150.73	gray, blk, cub, monoc	5.225	882	1230	0.000002 ¹⁸		s eth, dil H ₂ SO ₄ , HCl
t229	(IV) sulfide	Mosand gold, SnS ₂	182.82	gold, yel, hex	4.5	d 600		0.0002 ¹⁹		d HCl, alk, (NH ₄) ₂ S
t230	(IV) sulfur chloride	SnCl ₄ · 2SCl ₂	608.25	yel, cr		37	50-140	sl	d	d alk sulf, aq reg, alk hydr, PCl ₅ , SnCl ₄ , i a
t231	tertrite	Sn ₃ Cl ₄ Te ₃	266.76	heavy, wh, powd				s		s eth, bz, CS ₂ , ethyl acet, d HNO ₃
t232	(II) telluride	SnTe	246.29	gray, cr	6.48	780	d			v s dil HCl
t233	(IV) telluride	SnTe ₂	373.89	blk, three ppt						d alk sulf
t234	Titanic acid, ortho-	α-Titanic acid, H ₂ TiO ₄	113.91	wh		d		v s, sl s, d		d dil a, alk
t235	Titanium	Ti	47.90	α hex, trig cub 8.38, sil, gray	4.538	1675	3260			s dil HCl, dil H ₂ SO ₄ , conc alk
t236	bromide, di-	TiBr ₂	69.52	hex	4.50	2900				s dil a
t237	bromide, di-	TiBr ₃	207.72	blk, powd	4.51	d > 500		s ev H ₂		
t238	bromide, tetra-	TiBr ₄	367.51	lor yel, deliq	2.6	39	230	d		s abs al, abs eth
t239	bromide, tri-	TiBr ₃ · 6H ₂ O	395.72	reddish viol or dk blue or, deliq		115	d 100	v s		v s al, acet
t240	carbide	TiC	59.91	gr met, cub	4.93	3110-190	4820			
t241	chloride, di-	TiCl ₂	118.81	lt br blk, hex, deliq	3.13	subl H ₂	d 475 vac	d		s aq reg, HNO ₃
t242	chloride, tetra-	TiCl ₄	189.71	lt yel liq, 1.61 ¹⁹ , br 1.726		-25	136.4	s	d	s eth, CS ₂
t243	chloride, tri-	TiCl ₃	154.26	dk viol, deliq	2.64	d 440	660 ¹⁹	s	s	s dil HCl, ad
t244	fluoride, tetra-	TiF ₄	123.89	wh, powd, hygr	2.798 ²⁰	> 400 (pressure)	284 (subl.)	s d		v s al; s HCl, i eth
t245	fluoride, tri-	TiF ₃	101.90	purplered or vlt	3.40	1200	1400	red s vlt		s H ₂ SO ₄ , al, CaH ₂ N, i eth
t246	hydride	TiH ₂	49.92	gray, powd	3.99	d 400				
t247	iodide, di-	TiI ₂	301.71	blk, hygr	4.99	600	1000	d		d alk; s conc HF, conc HCl
t248	iodide, tetra-	TiI ₄	555.52	red, cub	4.3	150	377.1	v s	d	sl s hot aq reg + HF
t249	nitride	TiN	61.91	yel-bronze, cub	5.22	2930				s al, eth
t250	oxalate	Ti ₂ C ₂ O ₄ · 10H ₂ O	540.91	vel pr				s		s H ₂ SO ₄ , alk; i s
t251	oxide, di-	Nat. brookite, TiO ₂	79.90	wh, rhomb, 2.583, 2.586, 2.741	4.17	1825				s H ₂ SO ₄ , alk; i s
t252	oxide, di-	Nat. rutile, anatase, TiO ₂	79.90	br-blk, tetr, 2.554, 2.493	3.84					s H ₂ SO ₄ , alk; i s

PHYSICAL CONSTANTS OF INORGANIC COMPOUNDS (Continued)

No.	Name	Synonyms and Formulae	Mol. wt.	Crystalline form, properties and index of refraction	Density or spec. gravity	Melting point, °C	Boiling point, °C	Solubility, in grams per 100 cc			
								Cold water	Hot water	Other solvents	
Zinc											
s59	orthophosphate, tetrahydrate	α -Hopeite, $\text{Zn}_3(\text{PO}_4)_2 \cdot 4\text{H}_2\text{O}$	458.11	col, rhomb, 1.572, 1.591, 1.59	3.04	tr >105				v a a, NH_4OH , $\text{NH}_4\text{ salts}$	
s60	orthophosphate, tetrahydrate	β -Hopeite, $\text{Zn}_3(\text{PO}_4)_2 \cdot 4\text{H}_2\text{O}$	458.11	col, rhomb, 1.574, 1.582, 1.582	3.03	tr >140				v a a, NH_4OH , $\text{NH}_4\text{ salts}$	
s61	orthophosphate, tetrahydrate	Parahopeite, $\text{Zn}_3(\text{PO}_4)_2 \cdot 4\text{H}_2\text{O}$	458.11	col, tricl, 1.614, 1.625, 1.665	3.75	tr >163				v a a, NH_4OH , $\text{NH}_4\text{ salts}$	
s62	pyrophosphate	$\text{Zn}_2\text{P}_2\text{O}_7$	304.68	wh powd	3.75 ^u					v a a, alk, NH_4OH	
s63	phosphide	Zn_3P_2	258.06	dk gray, tetrag, poss	4.55 ^u	>420	1100; aubl in H_2			d H_2SO_4 , ev H_2P a HNO_3 s (viol) dil a; i al s alk	
s64	hypophosphite	$\text{Zn}(\text{H}_2\text{PO}_2)_2 \cdot \text{H}_2\text{O}$	213.36	col, cr powd, hydr						s alk	
s65	picrate	$\text{Zn}(\text{C}_6\text{H}_3\text{N}_3\text{O}_7)_2 \cdot 8\text{H}_2\text{O}$	665.69	yel cr powd, expl		expl					
s66	selenate	$\text{Zn}(\text{C}_6\text{H}_4\text{O}_6)_2 \cdot 3\text{H}_2\text{O}$	393.65	need				5 ^u		s al	
s67	selenate	$\text{ZnSeO}_4 \cdot 5\text{H}_2\text{O}$	298.40	wh, tricl	2.591 ^u	d >50					
s68	selenide	ZnSe	144.33	yellow to redish, cub, 2.89	5.42 ^u	>1100				s a, d HNO_3	
s69	silicate	Nat. hemimorphite, $2\text{ZnO} \cdot \text{SiO}_2 \cdot \text{H}_2\text{O}$	240.84	rhomb, or trigon, 1.614, 1.617, 1.636	3.45						
s70	metasilicate	ZnSiO_3	141.45	col, rhomb	3.42	1437				s a	
s71	orthosilicate	Nat. willemite, Zn_2SiO_4	222.82	trig, 1.694, 1.723	4.103	1509				s a, s al, eth	
s72	stearate	$\text{Zn}(\text{C}_{18}\text{H}_{35}\text{O}_2)_2$	632.33	light powd		130					
s73	sulfate	Nat. sinkowite, ZnSO_4	161.43	col, rhomb, 1.658, 1.669, 1.670	3.54 ^u	d 600				s al, s al, s MeOH, glyc	
s74	sulfate, heptahydrate	Nat. goslarite, $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$	287.54	col, rhomb, eff, 1.457, 1.480, 1.484	1.957 ^u	100	-71 \pm 0, 280, 96.5 ^u		663.0 ^u	s al, s al, glyc	
s75	sulfate, hexahydrate	$\text{ZnSO}_4 \cdot 6\text{H}_2\text{O}$	269.52	col, monocel or tetrag	2.072 ^u	-51 \pm 0, 70			117.5 ^u		
s76	sulfide, (α)	Nat. wurtzite, ZnS	97.43	col, hex, 2.356, 2.378	3.98	1850 ^u \pm 10	subl 1185	0.00069 ^u		v a a; i a c a	
s77	sulfide, (β)	Nat. sphalerite, ZnS	97.43	col, cub, 2.368	4.102 ^u	tr 1020		0.000065 ^u		v a a	
s78	sulfide, monohydrate	$\text{ZnS} \cdot \text{H}_2\text{O}$	115.45	yellow-wh powd	3.98	1049				s a	
s79	sulfite	$\text{ZnSO}_3 \cdot 2\text{H}_2\text{O}$	181.46	wh, cr powd		-21 \pm 0, 100 d 200		0.16		s al, a H_2SO_4	
s80	tartrate	$\text{Zn}(\text{C}_4\text{H}_4\text{O}_6)_2 \cdot 2\text{H}_2\text{O}$ (or $2\text{H}_2\text{O}$)	231.46	wh powd				0.055 ^u		s KOH, NaOH	
s81	tellurate	ZnTeO_4	419.71	wh, gran ppt						s a	
s82	telluride	ZnTe	192.97	red, cub, 3.56	6.34 ^u	1238.5				s a	
s83	thiocyanate	$\text{Zn}(\text{SCN})_2$	181.53	wh powd, deliq						s al, NH_4OH	
s84	valerate	$\text{Zn}(\text{C}_6\text{H}_5\text{O}_2)_2 \cdot 2\text{H}_2\text{O}$	303.65	wh glauc or powd				2.6 ^u \pm 0.1		ca 2.5 al; v a s eth	
s85	Zinc complexes	$[\text{Zn}(\text{NH}_3)_4]\text{Cl}_2$	170.34	col, rhomb, 1.625, 1.590	2.10	210.8	d 271				
s86	tetrammine perchlorate	$[\text{Zn}(\text{NH}_3)_4](\text{ClO}_4)_2$	633.89	wh, cub cr	3.608 ^u					0.1852 conc NH_4OH	
s87	tetrapyrindine fluosilicate	$[\text{Zn}(\text{C}_5\text{H}_5\text{N})_4]\text{SiF}_6$	523.86	wh, rhomb	2.197						
s88	Zirconium	Zr	91.22	silver gray, met	6.49	1852 \pm 2	3578			s HF, aq reg; s a a	
s89	bromide, di-	ZrBr_2	251.04	blk powd, ign in air		d >350			d ev H_2		
s90	boride, di-	ZrB_2	112.84	hex	6.085	ca 3000					
s93	bromide, tetra-	ZrBr_4	410.86	wh cr powd, deliq		450 \pm 10 ^u \pm 10	357 aubl			s liq NH_3 , acetone; i bz, CCl_4	
s94	bromide, tri-	ZrBr_3	330.95	bl-blk powd		d 350			d ev H_2		
s95	carbide	ZrC	103.23	gray met, cub	6.73	3540	5100			s a conc H_2SO_4	
s96	carbonate, basic	$3\text{ZrO}_2 \cdot \text{CO}_2 \cdot \text{H}_2\text{O}$	431.68	wh, amorph powd						s a	
s97	chloride, di-	ZrCl_2	162.13	blk	3.6 ^u	d 350			d ev H_2		
s98	chloride, tetra-	ZrCl_4	233.03	wh cr	2.803 ^u	437 ^u \pm 10	subl 331			s al, eth, conc HCl	
s99	chloride, tri-	ZrCl_3	197.58	br cr	3.00 ^u	d 350			d ev H_2	s - H_2 conc al; i org cpd	
s100	fluoride	ZrF_4	167.21	wh hex, 1.59	4.43	subl \sim 600		1.388 ^u		s a HF	
s101	hydride	ZrH_2	93.24	gray-blk powd						s dif HF, conc a	
s102	hydroxide	$\text{Zr}(\text{OH})_4$	159.25	wh amorp powd	3.25	-21 \pm 0, 500		0.02		s min a	
s103	iodide	ZrI_4	598.84	wh need, hydr		499 \pm 2, 6.3 ^u \pm 0.1	d \sim 600			d al; s eth; v a s CS_2 , bz; i liq NH_3 s al	
s104	nitrate	$\text{Zr}(\text{NO}_3)_4 \cdot 5\text{H}_2\text{O}$	429.32	col cr, deliq, 1.60, 1.61							

THE MERCK INDEX

AN ENCYCLOPEDIA OF
CHEMICALS AND DRUGS

NINTH EDITION

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1976

2,533,660 (1950 to du
tive Inorganic Chemis-
press, New York, 2nd

ost tasteless powder.
ter; sol in acids with

p-Hydroxybenzenesul-
carbolate: calcium sul-
386.40. C 37.30%, H
Ca[C₆H₄(OH)SO₃]₂.
is vol. 2, 420 (Berlin.

ol in water or alcohol.
bitter, astringent taste.
s an intestinal antisept-
in ophthalmic solns.

um carbolate; calcium
m phenylate. C₁₂H₁₀
4.45%, Ca 17.72%, O
ge. Drake. U.S. pat.

lightly sol in water or

r oils.

ic. Calcium monohy-
phosphate; secondary
136.06. Ca 29.46%, H
O. Occurs in nature as

CaCl₂ and Na₂HPO₄.
(1953); from Ca₃(PO₄)₂
16 (1960), where it is an
hydroxyapatite.

hydrated to calcium py-
ater, alcohol.

crystals. Loses water of
at red heat to calcium

/ insol in water, alcohol;
l in dil acetic acid.

eral supplement in cere-

; in dental products, fer-

s. Monobasic).

as a dietary supplement.

monobasic. Acid calcium
nonocalcium orthophos-
mary calcium phosphate;
P₂; mol wt 234.06. Ca
17%. Ca(H₂PO₄)₂. Com-
ing pulverized phosphate
Keyes & Clark's Industri-
York, 4th ed., 1975) pp
CaCO₃ and H₃PO₄; Jen-
53).

linic plates, cryst powder
when pure, but traces of
material to be deliquesce.
X⁰, dec at 200°. d₄²⁰ 2.220.
l HCl or HNO₃ or acetic

om commercial processes
hosphate. The **superphos-**
treatment is about 30%
45% CaSO₄, 10% iron
water; it contains 18-21%
osphate obtained from the
43 to 50% available P₂O₅.
idulant in baking powders
ement for foods and feeds;

ibasic. Tricalcium ortho-
e; tertiary calcium phos-
P₃; mol wt 310.20. Ca
a₃(PO₄)₂. It is about 96%

pure, usually contg an excess of CaO. Occurs in nature as
the minerals: *oxyapatite*, *voelcherite*, *whitlockite*. The tech-
nical product is also known as "*bone ash*". Commercial
prepn from phosphate rock: Hignett, Hubbard, *Ind. Eng.*
Chem. 38, 1208 (1946); Elmore, U.S. pat. 2,474,831 (1949 to
T.V.A.); Hollingsworth, U.S. pats. 2,556,541 and 2,562,718
(both 1951 to Coronet Phosphate); Brosheer, Hignett,
Chem. Eng. Rept. no. 7, 143 pp (1953).

Amorphous, odorless, tasteless powder. mp 1670°. d
3.14. Practically insol in water, alcohol or acetic acid; sol in
dil HCl or HNO₃.

USE: Manuf of fertilizers, H₃PO₄ and P compds; manuf
milk-glass, polishing and dental powders, porcelains, pot-
tery; enameling; clarifying sugar syrups; in animal feeds; as
noncaking agent; in the textile industry.

THERAP CAT: Calcium replenisher.

THERAP CAT (VET): Has been used as a dietary supplement,
and as an antacid.

1696. Calcium Phosphide. Photophor. Ca₃P₂; mol wt
182.20. Ca 65.99%, P 34.01%. Prepn: Ehrlich in *Handbook*
of Preparative Inorganic Chemistry, vol. 1, G. Brauer, Ed.
(Academic Press, New York, 2nd ed., 1963) p 943.

Red-brown cryst powder or gray lumps. Dec by moist air
or water, evolving spontaneously-flammable phosphine. d
2.51; mp about 1600°. Keep dry and tightly closed.

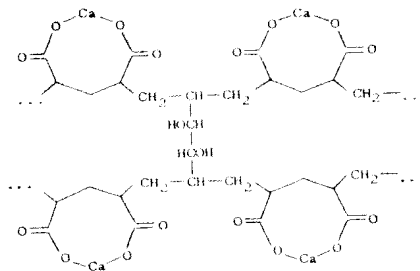
USE: For signal fires; in purification of Cu and Cu alloys;
as rodenticide.

1697. Calcium Phosphite. CaHO₂P; mol wt 120.07. Ca
33.38%, H 0.84%, O 39.98%, P 25.80%. CaHPO₃. Prepn:
Gmelin's, Calcium (8th ed.) 28B, 1121 (1958).

Monohydrate, crystals. Loses water at 200°; dec above
300°. Slightly sol in water; practically insol in alcohol.

USE: Fertilizers; polymerization catalyst.

1698. Calcium Polycarboxyl. Carboxyl; Quival. Calcium
salt of a synthetic loosely crosslinked hydrophilic resin of
the polycarboxylic type. Commercial development:
White Laboratories.



THERAP CAT: Antidiarrheal.

1699. Calcium Propionate. *Propionic acid calcium salt*;
Mycoban. C₈H₁₆CaO₄; mol wt 186.22. C 38.70%, H 5.41%,
Ca 21.52%, O 34.37%. Ca(CH₃CH₂COO)₂. Occurs as
mono- or trihydrate. Prepn: *Beilstein* vol. 2, 238, 2nd
suppl., 218, 3rd suppl., 516.

Powder or monoclinic crystals. Sol in water; slightly sol
in methanol, ethanol; practically insol in acetone, benzene.
USE: As an inhibitor of molds and other microorganisms
in foods, tobacco, pharmaceuticals; in butyl rubber to im-
prove processability and scorching resistance.

THERAP CAT: Antifungal.

1700. Calcium Pyrophosphate. Calcium diphosphate.
Ca₂O₇P₂; mol wt 254.12. Ca 31.54%, O 44.08%, P 24.38%.
Ca₂P₂O₇. Prepn by ignition of CaHPO₄. St. Pierre, *J. Am.*
Chem. Soc. 77, 2197 (1955).

Polymorphous crystals or powder. d 3.09. mp 1353°. Practically insol in water; sol in dil HCl or HNO₃.

USE: Abrasive; fertilizer; feed supplement; in dentifrices,
ceramic ware, china, glass, phosphors.

1701. Calcium D-Saccharate. D-Glucaric acid calcium

salt. C₆H₈CaO₇; mol wt 248.21. C 29.03%, H 3.25%, Ca
16.15%, O 51.57%. CaC₆H₈O₇. The normal calcium salt of
D-saccharic acid, a dicarboxylic sugar acid derived from the
oxidation of D-gluconic acid. Calcium D-saccharate is a true
chemical compd and should not be confused with saccharat-
ed lime, formerly called "calcium saccharate" and produced
by the action of lime upon sugar. Prepn: *Beilstein*, vol. 3,
2nd suppl., 378; *Hagers Handb. Pharm. Praxis* vol. 1, 755
(Berlin, 1930).

Tetrahydrate, odorless, tasteless crystals or fine white
powder. Stable to air. Becomes anhyd upon heating at
100° in vacuo. Practically insol in water, alcohol, ether. Sol
in dil mineral acids and in calcium gluconate solns.

USE: As plasticizer in cement, concrete, mortar.

THERAP CAT: Pharmaceutic aid (stabilizer for calcium glu-
conate solns).

1702. Calcium Salicylate. 2-Hydroxybenzoic acid calci-
um salt. C₁₄H₁₀CaO₆; mol wt 314.30. C 53.50%, H 3.21%,
Ca 12.75%, O 30.54%. Ca[C₆H₄(OH)COO]₂. Prepn: Co-
ninck, *Rec. Gen. Chim.* 17, 72 (1914).

Dihydrate, monoclinic crystals or powder. Odorless;
tasteless. Loses all H₂O at 120°. Decomposes at 244° to
phenol, the basic salicylate, CO₂ and H₂O. Soly in water
(15.5°): 28.46 g/l; soly in ethanol (16.7°): 15.5 parts/l;
slightly sol in methyl acetate; sol in methanol. The aq soln
is slightly acid and light sensitive.

1703. Calcium Selenate. CaO₄Se; mol wt 183.04. Ca
21.90%, O 34.97%, Se 43.14%. CaSeO₄. Prepn: Mitscher-
lich, *Pogg. Ann.* 9, 623 (1827); von Hauer, *Sitzungsber. Akad.*
Wien 39, 299, 839 (1860); Lehner, Kao, *J. Am. Chem. Soc.*
47, 1521 (1925).

Dihydrate, monoclinic crystals. d₂₀²⁵ 2.69. Gradually loses
H₂O on heating becoming anhyd by 200°; dec to CaSeO₃ at
698°. Sol in water.

USE: Pesticide.

1704. Calcium Selenide. CaSe; mol wt 119.04. Ca
33.67%, Se 66.33%. Prepd by reducing CaSeO₄ in a stream
of H₂ at 400-500°. Ehrlich in *Handbook of Preparative In-*
organic Chemistry, vol. 1, G. Brauer, Ed. (Academic Press,
New York, 2nd ed, 1963) p 939.

White powder. In air may turn red within a few minutes
and light brown in a few hours. d 3.82. Decomposed by
water. Treatment with HCl produces H₂Se gas, and red Se
separates.

USE: In electron emitters.

1705. Calcium Silicate. Many different forms of calcium
silicate are known. Among the most common forms are
CaSiO₃, Ca₂SiO₄ and Ca₃Si₂O₇. Usually occur in hydrated
form contg various percentages of water of crystallization.
Names of calcium silicate minerals are: *afwillite*; *akerman-*
ite; *calcium pectolite*; *centrallite*; *crestmorite*; *eakite*;
foshagite; *foshallite*; *gjellevaekite*; *grammite*; *gyrolite*; *hille-*
brandite; *larnite*; *okenite*; *parawollastonite*; *pseudo-wollaston-*
ite; *riversideite*; *table spate*; *tobermorite*; *wollastonite*; *xonal-*
ite; *xonotlite*. Commercial calcium silicate sold for industri-
al use, such as *Micro-Cell* and *Silene*, is prepared syntheti-
cally to control its absorbing power. The usual method of
prepn is from lime and diatomaceous earth under carefully
controlled conditions: Boss, *Chem. Eng. News* 27, 677
(1949); Steinour, *Chem. Revs.* 40, 391 (1947). The commer-
cial product is described here.

White or slightly cream-colored, free-flowing powder.
Approximate analysis: CaO 19%, SiO₂ 67%, H₂O 6 to 8%.
d₂₅²⁵ 2.10. Bulk density: 15 to 16 lb/cu ft. Absorbs 1 to 2.5
times its weight of liquids and still remains a free-flowing
powder. Total absorption power for water about 600%, for
mineral oil about 500%. Available surface area: 95 to 175
m²/g. Ultimate particle size: 0.02 to 0.07 μ. pH of aq slurry
8.0 to 10.0. Practically insol in water. Forms a siliceous gel
with mineral acids.

USE: Constituent (produced *in situ*) of lime glass, portland
cement; reinforcing filler in elastomers and plastics; absorb-
ent for liquids, gases, vapors; as anti-caking agent, suspen-
sion agent, pigment and pigment extender; binder for refrac-
tory material; in chromatography; in road construction.

1706. Calcium Stearate. Octadecanoic acid calcium salt;
stearic acid calcium salt. C₃₄H₇₀CaO₄; mol wt 607.00. C

ve and smooth muscle-proteolysis of kininogen (*q.v.*). The decapeptide nin (*q.v.*): Werle *et al.*, synthesis: Nicolaidis *et al.*, 6, 210 (1961); Pless *et*

er-Pro-Phe-Arg

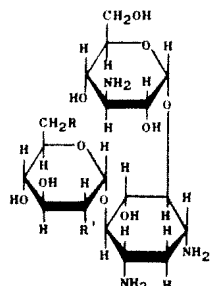
57° (c = 1 in N acetic acid/water system (70:

idutin; Padreatin; Glu-Dirculetin. Hypotensive plasma proteins. Major a. glandular tissues, and : pancreas, parotid and all, in feces, in duodenal y. Isolin from mammali-dier, *C.R. Soc. Biol.* 64, *Exp. Biol. Med.* 93, 181 (1960); Werle, Trautschold, Plasma kallikrein diffe- rin. The latter two lib- es bradykinin, *q.v.*, both nogen. Pharmacology: *orsch.* 10, 779 (1960). 9, 509 (1969); Suzuki *et* 970).

a; spoonwood. Glands *Mallotus philippinensis* it. Philippine Islands. Rottlerin, isorathlerin. *Indian J. Pharm.* 11, 37

l as purgative, teniacide.

complex produced by & Umezawa from Japan- 10A, 181 (1957); U.S. d of three components. it (usually designated as C, two minor congeners. ins A and B and their i, Hardcastle, U.S. pats. l both to Bristol-Myers). tter, U.S. pat. 3,032,547 anamycin C: Murase *et* Studies on kanamycin B: ructure of kanamycin A: 58); Cron *et al.*, *J. Am.* ure of kanamycin B: Ito Structure of kanamycin Absolute configuration of *J. Am. Chem. Soc.* 85, ll. *Chem. Soc. Japan* 39, anamycin A: Koyama *et* Monograph: *Ann. N.Y.* 108 (1958). Synthesis of *Antibiot.* 21, 367 (1968); 1968, 623; Umezawa *et* 33 (1969). Synthesis of , 424 (1968); *Bull. Chem.* sis of kanamycin C: *ei-* n. 21, 162 (1968). Effects , *ibid.* 23, 99 (1970).



kanosamin

deoxystreptamine

Kanamycin A, $C_{18}H_{34}N_4O_{11}$. R = NH₂; R' = OH. Crystals from methanol + ethanol. $[\alpha]_D^{25} +146^\circ$ (0.1 N H₂SO₄). LD₅₀ i.v. in mice: 583 mg/kg.

Kanamycin A sulfate, *Cantrax*, *Cristalomicina*, *Kamycin*, *Kamynex*, *Kanacedin*, *Kanamytrex*, *Kanasig*, *Kanicin*, *Kanasyn*, *Kantrex*, *Kantrox*, *Otokalixin*, *Resistomycin* (Bayer), *Ophthalmokalixan*, *Kantrexil*, *Kano*, *Kanescin*, *Kanaqua*. (U.S.P. requires that kanamycin sulfate contains not less than 75% kanamycin A and not more than 5% kanamycin B sulfate on an anhydrous basis.) Irregular prisms, dec over a wide range above 250°C. Freely sol in water; practically insol in the common alcohols and nonpolar solvents. LD₅₀ in mice: 20.7 g/kg orally; 1450 mg/kg i.p.; Zel'tser *et al.*, *Antibiotiki* 19, 552 (1974).

Kanamycin B, $C_{18}H_{32}N_4O_{10}$, NK 1006, *bekanamycin*, *aminodeoxykanamycin*. R = R' = NH₂. Crystals, mp 178-182° (dec). $[\alpha]_D^{25} +130^\circ$ (c = 0.5 in water). $[\alpha]_D^{25} +114^\circ$ (c = 0.98 in water). Soluble in water, formamide; slightly sol in chloroform, isopropyl alcohol; practically insol in the common alcohols and nonpolar solvents. LD₅₀ i.v. in mice: 136 mg/kg.

Kanamycin B sulfate, *Kanendomycin*. **Kanamycin C**, $C_{18}H_{34}N_4O_{11}$. R = OH; R' = NH₂. Crystals from methanol + ethanol, dec above 270°. $[\alpha]_D^{25} +126^\circ$ (H₂O). Sol in water; slightly sol in formamide. Practically insol in the common alcohols and nonpolar solvents. THERAP CAT: Antibacterial.

5133. Kaolin. Bolus alba; China clay; porcelain clay; white bole; argilla. Essentially a hydrated aluminum silicate, approximately H₂Al₂Si₂O₈·H₂O. Prepared for pharmaceutical and medicinal purposes by levigating with water to remove sand, etc.

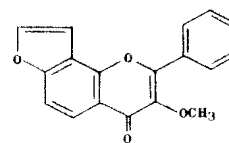
White or yellowish-white, earthy mass or white powder; unctuous when moist. Insol in water, cold acids or in alkali hydroxides.

USE: Manuf porcelain, pottery, bricks, Portland cement; ultramarine, color lakes, refractory mortar; plaster material, filler for paper; electric and heat insulators; clarifying liquids; drying and emollient agent.

THERAP CAT: Adsorbent.

THERAP CAT (VET): Topical and G.I. adsorbent. Poultice.

5134. Karanjin. 3-Methoxy-2-phenyl-4H-furo[2,3-h]-1-benzopyran-4-one. $C_{19}H_{12}O_5$; mol wt 292.28. C 73.96%, H 4.14%, O 21.90%. From *Pongamia glabra* Vent., *Leguminosae*: Beal, Katti, *J. Am. Pharm. Assoc.* 14, 1086 (1925); Rao, Rao, *J. Indian Chem. Soc.* 17, 526 (1940); Bhat *et al.*, *J. Am. Oil Chem. Soc.* 33, 197 (1956). Structure: Limaye, *Rasayanam* 1, 1 (1936), *C.A.* 31, 2206⁹ (1937); Manjunath *et al.*, *Ber.* 72B, 39 (1939). Synthesis: Seshadri, Venkateswarlu, *Proc. Indian Acad. Sci.* 13A, 404 (1941); 17A, 16 (1943); Kawase *et al.*, *Bull. Chem. Soc. Japan* 28, 273 (1955); Rao, Seshadri, *Proc. Indian Acad. Sci.* 33A, 168 (1951); Aneja *et al.*, *Tetrahedron* 2, 203 (1958); Raizada *et al.*, *J. Sci. Ind. Res.* 19B, 76 (1960).



Needles from methanol, mp 157-158°. Sol in methanol, ethanol, chloroform, benzene, ether, concd H₂SO₄, HNO₃, HOAc, HCl; practically insol in petr ether, dil mineral acids.

5135. Karaya Gum. Gum karaya; kadaya; katilo; kullo; kuteera; sterculia; Indian tragacanth; mucara. The dried exudate of the tree *Sterculia urens* Roxb., *Sterculiaceae*, found in India, especially in the Gujerat region and in the central provinces: Toothaker, *The Soluble Gums* (Philadelphia, 1921); Mantell, *The Water-Soluble Gums* (New York, 1947). Constituents and structure: Hirst, Dunstan, *J. Chem. Soc.* 1953, 2332. Structure is a partially acetylated polysaccharide containing about 8% acetyl groups and about 37% uronic acid residues. Reviews: F. Smith, R. Montgomery, *The Chemistry of Plant Gums and Mucilages* (Reinhold, New York, 1959); Goldstein, Alter, in *Industrial Gums*, R. L. Whistler, Ed. (Academic Press, New York, 2nd ed., 1973) pp 273-287.

Finely ground white powder, faint odor of acetic acid. Acid to litmus. Absorbs water rapidly to form viscous mucilages at low concs. Viscosity decreases on addn of acid or alkali. Color of the soln lightens in acidic media and darkens in alkaline soln due to the presence of tannins. Gum karaya loses viscosity forming ability when stored in the dry state, the loss being greater for a powdered material than for the crude gum. Cold storage inhibits this degradation.

USE: As denture adhesive; as binder in paper manuf; as meringue stabilizer; as thickening agent for dyes in textile industry. A substitute for gum tragacanth.

THERAP CAT: Cathartic.

5136. Karzil. N-(3,4-Dichlorophenyl)-2-methylpentanamide; 3',4'-dichloro-2-methylvalerianilide; Niagara 4562. $C_{12}H_{15}Cl_2NO$; mol wt 260.17. C 55.40%, H 5.81%, Cl 27.26%, N 5.38%, O 6.15%. Prep'd from 3,4-dichloroaniline and 2-methylvaleryl chloride: Dorschner *et al.*, *Brit. pat.* 869,169 (1961 to FMC).



Crystals, mp 106-107°.

USE: Herbicide.

5137. Kationium. A brand of sodium-adsorbent exchange resin; styronate resin, made from ammonium polystyrene sulfonate 75%, and potassium polystyrene sulfonate 25% [Winthrop-Stearns].

THERAP CAT: Ion exchange resin (sodium adsorption).

5138. Kava. Kava-kava; ava-ava; kawa. Dried rhizome and roots of *Piper methysticum* Forst., *Piperaceae*. *Habit.* Polynesia. Most important constituents are: kawain, dihydrokawain, methysticin, dihydromethysticin, and yangonin: Borsche, Lewinsohn, *Ber.* 66, 1792 (1933) and references to preceding papers therein. Chemical and pharmacological investigation of the kava constituents: Klohs *et al.*, *J. Med. Pharm. Chem.* 1, 95 (1959); Meyer, Kretzschmar, *Klin. Wochenschr.* 44, 902 (1966). Review of chemistry, pharmacology and historical sketch: *U.S. Public Health Service Publ. No.* 1645, D. H. Efron, Ed., pp 103-181 (1967).

Note: Kava is also the popular name for the intoxicating drink prepared from the plant's roots.

5139. Kawain. (R)-5,6-Dihydro-4-methoxy-6-(2-phenylethenyl)-2H-pyran-2-one; 5-hydroxy-3-methoxy-7-phenyl-2,6-heptadienoic acid δ-lactone; 4-methoxy-6-(β-phenyl-

fluffy powder. d_{20}^{25} 1.100-1.200. Sol in acids. With hydro- LiHF_2 . With lithium LiOH , mp 462°. LD

ing aluminum, in the s. Lithium fluoride tometers.

mol wt 51.96. C 6.52%, H 0.14%, O 1.46. Sol in 3 neutral.

wt 7.95. H 12.70%. Combination of hydro-*hem. Soc.* 93, 198-211. s. Truter in *Mellor's* (part 1) 131-145

exposure to light, the up 680°. d_{20}^{25} 0.76-0.77. water to form lithium h the lower alcohols, na at 400° to liberate

gent with ketones and erators: 1 g in water at STP.

hydrate. HLiO ; mol 80%. LiOH . Prepn: hen. *Inorg. Syn.* 5, 3 w of prepn. properties, supplement II. *The*

id, strongly alkaline. ur. d_{20}^{25} 2.54. mp 471°.

Keep tightly closed. stals. d_{20}^{25} 1.51. Heat of soln -0.87 at 0°; 10.7°; at 20°: alcohol. pH of a 1.0N

alkaline storage bat- here use of carbonate action of alkyl resins. ithium soaps, greases, ie and hence caustic, icity similar to other

wt 181.84. I 69.79%.

crystals. Sol in 1.5 ill closed.

133.83. I 94.82%. Li

s or fused masses; be- o liberation of iodine. about 0.5 part water etone. The aq soln is ly closed and protected

mol wt 68.95. Li

3. mp about 255°. Sol The aq soln is neutral.

mol wt 101.88. C O_4 . parts water.

t 29.88. Li 46.45%. O Cohen, *Inorg. Syn.* 5, avo, *ibid.* 7, 3 (1963). er in *Mellor's* vol. II, (rt 1) 146-158 (1961).

Finely divided powder or crusty material. d_{25}^{25} 2.013. mp 1570°. van Arkel *et al.*, *Can. J. Chem.* 31, 1009 (1953); 1427° (1700°K): Brewer, Margrave, *J. Phys. Chem.* 59, 421 (1955). Readily absorbs carbon dioxide and water from the atm. At elevated temp attacks glass, silica, many metals.

5377. Lithium Perchlorate. LiClO_4 ; mol wt 106.40. Li 6.52%, Cl 33.33%, O 60.15%. LiClO_4 .

Small crystals. d_{25}^{25} 2.43. mp 236°. Decompn starts at about 400° and becomes rapid at 430° yielding lithium chloride and oxygen. Heat of formation: -99.94 kcal/mol at 25°. Sol in water (w/w) at 0°: 29.9%; at 25°: 37.5%; at 100°: 71.5%. Appreciably sol in alcohol, acetone, ether, ethyl acetate.

USE: Oxidizing agent. Caution: May be irritating on contact with skin, mucous membranes.

5378. Lithium Phosphate. Li_3PO_4 ; mol wt 115.76. Li 17.98%, O 55.27%, P 26.75%. Li_3PO_4 .

Hemihydrate, white, cryst powder. Sol in about 2500 parts water; sol in dil acids.

5379. Lithium Rubidium Tetracyanoplatinate(II). Plat- inous lithium rubidium cyanide. $\text{C}_4\text{Li}_2\text{N}_4\text{PtRb}$; mol wt 391.58. C 12.26%, Li 1.77%, N 14.31%, Pt 49.84%, Rb 21.82%. $\text{LiRbPt}(\text{CN})_4$. (Contains a variable quantity of water.)

Greenish-yellow, cryst needles. Soluble in water. More strongly fluorescent in x-rays than platinum barium cyanide; hence used instead of the latter in fluoroscopy.

5380. Lithium Selenate. Li_2SeO_4 ; mol wt 149.90. Li 4.63%, O 42.70%, Se 52.67%. Prepd by roasting lithium selenite in air or by roasting lithium carbonate with selenium or selenium oxide: Lenher, Wechter, *J. Am. Chem. Soc.* 47, 1522 (1925).

Monohydrate, monoclinic crystals. d_{25}^{25} 2.565. Poisonous! Stable in air. Readily sol in water.

5381. Lithium Selenite. Li_2SeO_3 ; mol wt 133.90. Li 5.18%, O 35.85%, Se 58.97%. Li_2SeO_3 . Prepd from a soln of selenious acid in lithium hydroxide at 60°: Nilson, *Bull. Soc. Chim.* [2] 21, 253 (1874); *ibid.* [2] 23, 262 (1875).

Monohydrate, acicular crystals. Hygroscopic. More sol in cold water than in hot water.

5382. Lithium Silicate. Lithium metasilicate. $\text{Li}_2\text{O} \cdot \text{SiO}_2$; mol wt 89.97. Li 15.43%, O 53.35%, Si 31.22%. Li_2SiO_3 . Prepd by fusing Li_2CO_3 with SiO_2 . Schwarz, Sturm, *Ber.* 47, 1737 (1914).

Orthorhombic needles. d_{25}^{25} 2.52. mp 1201°. Heat of formation (solid): -434.9 kcal/mol. Heat of formation (liq) -374.6 kcal/mol. Latent heat of fusion (1177°) = 7.24 kcal/mol, also reported as -80.2 cal/g. Insol in cold water, dec by boiling water, dilute hydrochloric acid.

USE: To calibrate thermoelements.

5383. Lithium Sulfate. Lithium-Duriles. $\text{Li}_2\text{O} \cdot \text{S}_2\text{O}_8$; mol wt 109.88. Li 12.63%, O 58.25%, S 29.12%. Li_2SO_4 .

Monohydrate, colorless crystals; loses the water at 130°. d_{20}^{25} 2.06. Sol in 2.6 parts water; almost insol in alcohol. The aq soln is neutral.

THERAP CAT: Antidepressant.

5384. Lithium Tartrate. $\text{C}_4\text{H}_4\text{Li}_2\text{O}_6$; mol wt 161.95. C 29.66%, H 2.49%, Li 8.59%, O 59.28%.

Monohydrate, white, cryst powder. Sol in water. The aq soln is neutral or slightly alkaline to litmus.

5385. Lithium Tetracyanoplatinate(II). Platinoous lithium cyanide; lithium platinoocyanide. $\text{C}_4\text{Li}_2\text{N}_4\text{Pt}$; mol wt 313.04. C 15.35%, Li 4.43%, N 17.90%, Pt 62.32%. $\text{Li}_2\text{Pt}(\text{CN})_4$.

Pentahydrate, greenish-yellow crystals. Slightly sol in water.

USE: In x-ray photography.

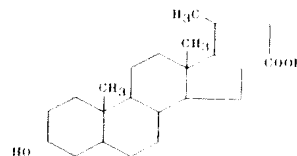
5386. Lithium Thiocyanate. Lithium sulfocyanate. LiNS ; mol wt 65.02. C 18.47%, Li 10.67%, N 21.54%, S 49.31%. LiSCN .

White, deliquescent crystals. Freely sol in water or alcohol. Keep well closed.

5387. Lithium Urate. *Uric acid lithium derivative*; lithium biurate; lithium acid urate. $\text{C}_5\text{H}_3\text{LiN}_4\text{O}_9$; mol wt 174.05. C 34.50%, H 1.74%, Li 3.99%, N 32.19%, O 27.58%.

White powder. Sol in 380 ml cold water, 39 ml boiling water; slightly sol in alcohol.

5388. Lithocholic Acid. *3 α -Hydroxy-5 β -cholan-24-oic acid; 3 α -hydroxycholic acid*; 17 β -(1-methyl-3-carboxy-propyl)etiocholan-3 α -ol. $\text{C}_{26}\text{H}_{46}\text{O}_3$; mol wt 376.56. C 76.55%, H 10.71%, O 12.75%. Found in ox bile, human bile, rabbit bile, and in ox and pig gallstones. Isoln: Fischer, *Z. Physiol. Chem.* 73, 234 (1911). Characterization: Wieland, Weyland, *ibid.* 110, 123 (1920). Prepn from cholic or from desoxycholic acid: Hoehn, Mason, *J. Am. Chem. Soc.* 62, 569 (1940); Sarel, Yanuka, *J. Org. Chem.* 24, 2018 (1959).



Hexagonal leaflets from alcohol, prisms from acetic acid, mp 184-186°. $[\alpha]_D^{20} +33.7^\circ$ ($c = 1.5$ in abs ethanol); $[\alpha]_D^{25} +23.3^\circ$ (Wieland); $[\alpha]_D^{20} +32.1^\circ$ (Fischer). Freely sol in hot alc. More sol in ether than cholic or desoxycholic acid. Sol in about 10 times its weight of ethyl acetate. Slightly sol in glacial acetic acid (about 0.2 g in 3 ml). More sol in benzene than desoxycholic acid. Insol in petr ether, gasoline, ligroin, water.

Methyl ester, $\text{C}_{25}\text{H}_{42}\text{O}_3$, crystallizes with $\frac{1}{2}$ mol methanol, mp 125-127°.

Ethyl ester, $\text{C}_{26}\text{H}_{44}\text{O}_3$, crystals, mp 92-93°.

Benzyl ester, $\text{C}_{31}\text{H}_{46}\text{O}_3$, crystals, mp 145-148°.

Acetylithocholic acid, $\text{C}_{28}\text{H}_{42}\text{O}_4$, crystals, mp 169°.

Acetylithocholic acid methyl ester, $\text{C}_{27}\text{H}_{44}\text{O}_4$, flat needles from pentane, mp 123-130°.

Acetylithocholic acid ethyl ester, $\text{C}_{28}\text{H}_{46}\text{O}_4$, crystals, mp 90-91°.

5389. Lithopone. Griffith's zinc white. A white pigment consisting of a mixture of zinc sulfide, barium sulfate and some zinc oxide. Made by pptn of ZnSO_4 with BaS and heating.

5390. Litmocidin. Antibiotic substance produced by *Proactinomyces cyaneusantibioticus*. Isoln: Gause, *J. Bacteriol.* 51, 649 (1946); Brazhnikova, *ibid.* 655; Abou-Zeid, El-Gammal, *Z. Allg. Mikrobiol.* 11, 5 (1971). Belongs to the class of pigments and shows some qualitative reactions as anthocyanidine: Brazhnikova, *C.A.* 41, 5576h (1947). Approx mol wt of 398-418: Pashkina, *Biokhimiya* 21, 448 (1956).

5391. Litmus. *Laemus; tournesol; turnsole; lacca musci; lacca coerulea*. Mol wt about 3300. Blue coloring matter from various species of lichens, particularly *Variolaria*, *Lecanora*, and *Rocella*. *Habit*. Scandinavia, shores of Mediterranean, Azores, California, East India, Madagascar. *Constit*. Chiefly azolitmin and erythrolitmin combined with alkalies: lecanoric acid, orcein, erythrolein. Manuf almost exclusively in Holland. Structure studies: Beecken *et al.*, *Angew. Chem.* 73, 665 (1961). Contains in small amounts α,β,γ -amino and hydroxyorcin.

Blue powder, lumps or cubes. Partly soluble in water or alcohol.

USE: As acid-base indicator; pH: 4.5 red, 8.3 blue. For preparing litmus papers; in microscopy to color culture media for diagnostic purposes. Has been used for coloring beverages.

5392. Liver Extract. An extract made from the livers of mammals. Upon ingestion or injection in a suitable dosage form it increases the number of red blood corpuscles in the blood of persons afflicted with pernicious anemia. Contains folic acid and vitamin B_{12} activity.

Some commercial products are: *Intraheptol; Pernaemon;*